```
EEEEEEEEEEEEEEE  MMM         MMM  UUU         UUU  LLL                AAAAAAAAA     TTTTTTTTTTTTTTT
EEEEEEEEEEEEEEE  MMM         MMM  UUU         UUU  LLL                AAAAAAAAA     TTTTTTTTTTTTTTT
EEEEEEEEEEEEEEE  MMM         MMM  UUU         UUU  LLL                AAAAAAAAA     TTTTTTTTTTTTTTT
EEE              MMMMMM   MMMMMM  UUU         UUU  LLL              AAA         AAA       TTT
EEE              MMMMMM   MMMMMM  UUU         UUU  LLL              AAA         AAA       TTT
EEE              MMMMMM   MMMMMM  UUU         UUU  LLL              AAA         AAA       TTT
EEE              MMM  MMM MMM  MMM UUU         UUU  LLL              AAA         AAA       TTT
EEE              MMM  MMM MMM  MMM UUU         UUU  LLL              AAA         AAA       TTT
EEE              MMM  MMM MMM  MMM UUU         UUU  LLL              AAA         AAA       TTT
EEEEEEEEEEEE     MMM      MMM  MMM UUU         UUU  LLL              AAA         AAA       TTT
EEEEEEEEEEEE     MMM      MMM  MMM UUU         UUU  LLL              AAA         AAA       TTT
EEEEEEEEEEEE     MMM      MMM  MMM UUU         UUU  LLL              AAA         AAA       TTT
EEE              MMM      MMM  MMM UUU         UUU  LLL              AAAAAAAAAAAAAAA       TTT
EEE              MMM      MMM  MMM UUU         UUU  LLL              AAAAAAAAAAAAAAA       TTT
EEE              MMM      MMM  MMM UUU         UUU  LLL              AAAAAAAAAAAAAAA       TTT
EEE              MMM      MMM  MMM UUU         UUU  LLL              AAA         AAA       TTT
EEE              MMM      MMM  MMM UUU         UUU  LLL              AAA         AAA       TTT
EEE              MMM      MMM  MMM UUU         UUU  LLL              AAA         AAA       TTT
EEEEEEEEEEEEEEE  MMM      MMM  MMM UUUUUUUUUUUUUUU  LLLLLLLLLLLLLLL  AAA         AAA       TTT
EEEEEEEEEEEEEEE  MMM      MMM  MMM UUUUUUUUUUUUUUU  LLLLLLLLLLLLLLL  AAA         AAA       TTT
EEEEEEEEEEEEEEE  MMM      MMM  MMM UUUUUUUUUUUUUUU  LLLLLLLLLLLLLLL  AAA         AAA       TTT
```

FILEID**VAXSTRING

```
VV      VV    AAAAAA    XX      XX    SSSSSSSS  TTTTTTTTTT  RRRRRRRR      IIIIII    NN      NN    GGGGGGGG
VV      VV    AAAAAA    XX      XX    SSSSSSSS  TTTTTTTTTT  RRRRRRRR      IIIIII    NN      NN    GGGGGGGG
VV      VV   AA    AA   XX      XX   SS            TT      RR      RR      II      NN      NN   GG
VV      VV   AA    AA   XX      XX   SS            TT      RR      RR      II      NN      NN   GG
VV      VV   AA    AA     XX  XX     SS            TT      RR      RR      II      NNNN    NN   GG
VV      VV   AA    AA     XX  XX     SS            TT      RR      RR      II      NNNN    NN   GG
VV      VV   AA    AA       XX         SSSSSS      TT      RRRRRRRR        II      NN  NN  NN   GG
VV      VV   AA    AA       XX         SSSSSS      TT      RRRRRRRR        II      NN  NN  NN   GG
VV      VV   AAAAAAAAAA     XX  XX           SS    TT      RR  RR          II      NN    NNNN   GG  GGGGGG
VV      VV   AAAAAAAAAA     XX  XX           SS    TT      RR  RR          II      NN    NNNN   GG  GGGGGG
  VV  VV     AA    AA     XX      XX         SS    TT      RR    RR        II      NN      NN   GG      GG
  VV  VV     AA    AA     XX      XX         SS    TT      RR    RR        II      NN      NN   GG      GG
    VV       AA    AA     XX      XX   SSSSSSSS    TT      RR      RR    IIIIII    NN      NN     GGGGGG
    VV       AA    AA     XX      XX   SSSSSSSS    TT      RR      RR    IIIIII    NN      NN     GGGGGG

LL            IIIIII      SSSSSSSS
LL            IIIIII      SSSSSSSS
LL              II      SS
LL              II      SS
LL              II      SS
LL              II      SS
LL              II        SSSSSS
LL              II        SSSSSS
LL              II              SS
LL              II              SS
LL              II              SS
LL              II              SS
LLLLLLLLLL    IIIIII    SSSSSSSS
LLLLLLLLLL    IIIIII    SSSSSSSS
```

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```
0000     1          .NOSHOW CONDITIONALS
0000     3          .TITLE  VAX$STRING      VAX-11 Character String Instruction Emulation
0000     7          .IDENT  /V04-001/
0000     8
0000     9  ;
0000    10  ;****************************************************************************
0000    11  ;*                                                                          *
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0000    28  ;*  SOFTWARE ON EQUIPMENT WHICH IS NOT SUPPLIED BY DIGITAL.                 *
0000    29  ;*                                                                          *
0000    30  ;*                                                                          *
0000    31  ;****************************************************************************
0000    32  ;
0000    33
0000    34  ;++
0000    35  ; Facility:
0000    36  ;
0000    37  ;       VAX-11 Instruction Emulator
0000    38  ;
0000    39  ; Abstract:
0000    40  ;
0000    41  ;       The routines in this module emulate the VAX-11 string instructions.
0000    42  ;       These procedures can be a part of an emulator package or can be
0000    43  ;       called directly after the input parameters have been loaded into
0000    44  ;       the architectural registers.
0000    45  ;
0000    46  ;       The input parameters to these routines are the registers that
0000    47  ;       contain the intermediate instruction state.
0000    48  ;
0000    49  ; Environment:
0000    50  ;
0000    51  ;       These routines run at any access mode, at any IPL, and are AST
0000    52  ;       reentrant.
0000    53  ;
0000    54  ; Author:
0000    55  ;
0000    56  ;       Lawrence J. Kenah
0000    57  ;
0000    58  ; Creation Date:
0000    59  ;
0000    60  ;       16 August 1982
0000    61  ;
```

```
0000     62 ; Modified by:
0000     63 ;
0000     64 ;       V04-001 LJK0044         Lawrence J. Kenah       6-Sep-1984
0000     65 ;               The backup code for MOVTC when moving in the forward direction
0000     66 ;               also needs to be changed (see LJK0039) based on the relative
0000     67 ;               sizes of the source and destination strings.
0000     68 ;
0000     69 ;       V01-005 KDM0107         Kathleen D. Morse       21-Aug-1984
0000     70 ;               Fix bug in CMPC3.  Return C clear if string length is 0.
0000     71 ;
0000     72 ;       V01-004 LJK0039         Lawrence J. Kenah       20-Jul-1984
0000     73 ;               Mofify MOVTC backup code to reflect differences in register
0000     74 ;               contents when traversing strings backwards. There are two
0000     75 ;               cases based on the relative sizes of source and destination.
0000     76 ;
0000     77 ;       V01-003 LJK0026         Lawrence J. Kenah       19-Mar-1984
0000     78 ;               Final cleanup pass. Access violation handler is now called
0000     79 ;               STRING_ACCVIO. Set PACK_M_ACCVIO bit in R1 before passing
0000     80 ;               control to VAX$REFLECT_FAULT.
0000     81 ;
0000     82 ;       V01-002 LJK0011         Lawrence J. Kenah       8-Nov-1983
0000     83 ;               Fix three minor bugs in MOVTC and MOVTUC. Change exception
0000     84 ;               handling to reflect chenged implementation.
0000     85 ;
0000     86 ;       V01-001 Original        Lawrence J. Kenah       16-Aug-1982
0000     87 ;--
```

```
0000     89          .SUBTITLE       Miscellaneous Notes
0000     90 ;+
0000     91 ;       The following notes apply to most or all of the routines that appear in
0000     92 ;       this module. The comments appear here to avoid duplication in each routine.
0000     93 ;
0000     94 ;  1.   The VAX Architecture Standard (DEC STD 032) is the ultimate authority on
0000     95 ;       the functional behavior of these routines. A summary of each instruction
0000     96 ;       that is emulated appears in the Functional Description section of each
0000     97 ;       routine header.
0000     98 ;
0000     99 ;  2.   One design goal that affects the algorithms used is that these instructions
0000    100 ;       can incur exceptions such as access violations that will be reported to
0000    101 ;       users in such a way that the exception appears to have originated at the
0000    102 ;       site of the reserved instruction rather than within the emulator. This
0000    103 ;       constraint affects the algorithms available and dictates specific
0000    104 ;       implementation decisions.
0000    105 ;
0000    106 ;  3.   Each routine header contains a picture of the register usage when it is
0000    107 ;       necessary to store the intermediate state of an instruction (routine) while
0000    108 ;       servicing an exception.
0000    109 ;
0000    110 ;       The delta-PC field is used by the condition handler jacket to these
0000    111 ;       routines when it determines that an exception such as an access violation
0000    112 ;       occurred in response to an explicit use of one of the reserved
0000    113 ;       instructions. These routines can also be called directly with the input
0000    114 ;       parameters correctly placed in registers. The delta-PC field is not used in
0000    115 ;       this case.
0000    116 ;
0000    117 ;       Note that the input parameters to any routine are a subset of the
0000    118 ;       intermediate state picture.
0000    119 ;
0000    120 ;       Fields that are not used either as input parameters or to store
0000    121 ;       intermediate state are indicated thus, XXXXX.
0000    122 ;
0000    123 ;  4.   In the Input Parameter list for each routine, certain register fields that
0000    124 ;       are not used may be explicitly listed for one reason or another. These
0000    125 ;       unused input parameters are described as IRRELEVANT.
0000    126 ;
0000    127 ;  5.   In general, the final condition code settings are determined as the side
0000    128 ;       effect of one of the last instructions that executes before control is
0000    129 ;       passed back to the caller with an RSB. It is seldom necessary to explicitly
0000    130 ;       manipulate condition codes with a BIxPSW instruction or similar means.
0000    131 ;
0000    132 ;  6.   There is only a small set of exceptions that are reflected to the user in an
0000    133 ;       altered fashion, with the exception PC changed from within the emulator to
0000    134 ;       the site of the original entry into these routines. The instructions that
0000    135 ;       generate these exceptions are all immediately preceded by a
0000    136 ;
0000    137 ;               MARK_POINT      yyyy_N
0000    138 ;
0000    139 ;       where yyyy is the instruction name and N is a small integer. These names
0000    140 ;       map directly into instruction- and context-specific routines (located at
0000    141 ;       the end of this module) that put each instruction (routine) into a
0000    142 ;       consistent state before passing control to a more general exception handler
0000    143 ;       in a different module.
0000    144 ;-
```

```
                        .SUBTITLE       DECLARATIONS

; Include files:

                        $PSLDEF                         ; Define bit fields in PSL

                        .NOCROSS                        ; No cross reference for these
                        .ENABLE         SUPPRESSION     ; No symbol table entries either

                        PACK_DEF                        ; Stack usage for exception handling

                        .DISABLE        SUPPRESSION     ; Turn on symbol table again
                        .CROSS                          ; Cross reference is OK now

; Macro Definitions

                        .MACRO  _INCLUDE        OPCODE , BOOT_FLAG
                        .IF     NOT_DEFINED     BOOT_SWITCH
                                OPCODE'_DEF
                                INCLUDE_'OPCODE = 0
                        .IF_FALSE
                                .IF     IDENTICAL       <BOOT_FLAG> , BOOT
                                        OPCODE'_DEF
                                        INCLUDE_'OPCODE = 0
                                .ENDC
                        .ENDC
                        .ENDM   _INCLUDE

; External declarations

                        .DISABLE        GLOBAL

                        .EXTERNAL       VAX$REFLECT_FAULT

; PSECT Declarations:

                        .DEFAULT        DISPLACEMENT , WORD

                        .PSECT _VAX$CODE PIC, USR, CON, REL, LCL, SHR, EXE, RD, NOWRT, LONG

                        BEGIN_MARK_POINT                ; Set up exception mark points
```

```
0000    190          .SUBTITLE       Conditional Assembly Parameters
0000    191 ;+
0000    192 ; Functional Description:
0000    193 ;
0000    194 ;       It is possible to create a subset emulator, one that emulates
0000    195 ;       specific reserved instructions. This capability is currently exploited
0000    196 ;       to create a subset emulator for use by the bootstrap programs.
0000    197 ;
0000    198 ;       An instruction is included in the full emulator by making an entry
0000    199 ;       in the following table. If the optional second parameter is present
0000    200 ;       and equal to BOOT, then that instruction is included in the subset
0000    201 ;       emulator used by the bootstrap code.
0000    202 ;-
0000    203
0000    204          .NOCROSS                           ; No cross reference for these
0000    205          .ENABLE         SUPPRESSION        ; No symbol table entries either
0000    206
0000    207          _INCLUDE        MOVTC
0000    208          _INCLUDE        MOVTUC
0000    209          _INCLUDE        CMPC3 , BOOT
0000    210          _INCLUDE        CMPC5 , BOOT
0000    211          _INCLUDE        SCANC
0000    212          _INCLUDE        SPANC
0000    213          _INCLUDE        LOCC , BOOT
0000    214          _INCLUDE        SKPC
0000    215          _INCLUDE        MATCHC
0000    216          _INCLUDE        CRC
0000    217
0000    218          .DISABLE        SUPPRESSION        ; Turn on symbol table again
0000    219          .CROSS                             ; Cross reference is OK now
0000    220
0000    221          .NOSHOW         CONDITIONALS
0000    222
```

```
0000    225          .SUBTITLE       VAX$MOVTC - Move Translated Characters
0000    226 ;+
0000    227 ; Functional Description:
0000    228 ;
0000    229 ;       The source string specified by the  source  length  and  source  address
0000    230 ;       operands  is translated and replaces the destination string specified by
0000    231 ;       the destination length and destination address operands.  Translation is
0000    232 ;       accomplished  by using each byte of the source string as an index into a
0000    233 ;       256 byte table whose zeroth entry address  is  specified  by  the  table
0000    234 ;       address operand.  The byte selected replaces the byte of the destination
0000    235 ;       string.  If the destination string is longer than the source string, the
0000    236 ;       highest  addressed  bytes  of the destination string are replaced by the
0000    237 ;       fill operand.  If the destination string  is  shorter  than  the  source
0000    238 ;       string,  the  highest  addressed  bytes  of  the  source  string are not
0000    239 ;       translated and moved.  The operation of the  instruction  is  such  that
0000    240 ;       overlap  of  the  source  and  destination  strings  does not affect the
0000    241 ;       result.  If the destination string overlaps the translation  table,  the
0000    242 ;       destination string is UNPREDICTABLE.
0000    243 ;
0000    244 ; Input Parameters:
0000    245 ;
0000    246 ;       The following register fields contain the same information that
0000    247 ;       exists in the operands to the MOVTC instruction.
0000    248 ;
0000    249 ;               R0<15:0> = srclen       Length of source string
0000    250 ;               R1       = srcaddr      Address of source string
0000    251 ;               R2<7:0>  = fill         Fill character
0000    252 ;               R3       = tbladdr      Address of 256-byte table
0000    253 ;               R4<15:0> = dstlen       Length of destination string
0000    254 ;               R5       = dstaddr      Address of destination string
0000    255 ;
0000    256 ;       In addition to the input parameters that correspond directly to
0000    257 ;       operands to the MOVTC instruction, there are other input parameters
0000    258 ;       to this routine. Note that the two inixxxlen parameters are only
0000    259 ;       used when the MOVTC_V_FPD bit is set in the FLAGS byte.
0000    260 ;
0000    261 ;               R2<15:8>  = FLAGS       Instruction-specific status
0000    262 ;
0000    263 ;       The contents of the FLAGS byte must be zero (MBZ) on entry to this
0000    264 ;       routine from the outside world (through the emulator jacket or by
0000    265 ;       a JSB call). If the initial contents of FLAGS are not zero, the
0000    266 ;       actions of this routine are UNPREDICTABLE.
0000    267 ;
0000    268 ;       There are two other input parameters whose contents depend on
0000    269 ;       the settings of the FLAGS byte.
0000    270 ;
0000    271 ;       MOVTC_V_FPD bit in FLAGS is CLEAR
0000    272 ;
0000    273 ;               R0<31:16> = IRRELEVANT
0000    274 ;               R4<31:16> = IRRELEVANT
0000    275 ;
0000    276 ;       MOVTC_V_FPD bit in FLAGS is SET
0000    277 ;
0000    278 ;               R0<31:16> = inisrclen   Initial length of source string
0000    279 ;               R4<31:16> = inidstlen   Initial length of destination string
0000    280 ;
0000    281 ; Intermediate State:
```

```
                                ;
                                ;     31              23              15              07              00
                                ;    +---------------+---------------+---------------+---------------+
                                ;    |        initial srclen         |             srclen            | : R0
                                ;    +---------------+---------------+---------------+---------------+
                                ;    |                             srcaddr                           | : R1
                                ;    +---------------+---------------+---------------+---------------+
                                ;    |   delta-PC    |     XXXX      |     FLAGS     |     fill      | : R2
                                ;    +---------------+---------------+---------------+---------------+
                                ;    |                             tbladdr                           | : R3
                                ;    +---------------+---------------+---------------+---------------+
                                ;    |        initial dstlen         |             dstlen            | : R4
                                ;    +---------------+---------------+---------------+---------------+
                                ;    |                             dstaddr                           | : R5
                                ;    +---------------+---------------+---------------+---------------+
                                ;
                                ; Output Parameters:
                                ;
                                ;       Source string longer than destination string
                                ;
                                ;               R0 = Number of bytes remaining in the source string
                                ;               R1 = Address of one byte beyond last byte in source string
                                ;                    that was translated (the first untranslated byte)
                                ;               R2 = 0
                                ;               R3 = tbladdr    Address of 256-byte table
                                ;               R4 = 0 (Number of bytes remaining in the destination string)
                                ;               R5 = Address of one byte beyond end of destination string
                                ;
                                ;       Source string same size as or smaller than destination string
                                ;
                                ;               R0 = 0 (Number of bytes remaining in the source string)
                                ;               R1 = Address of one byte beyond end of source string
                                ;               R2 = 0
                                ;               R3 = tbladdr    Address of 256-byte table
                                ;               R4 = 0 (Number of bytes remaining in the destination string)
                                ;               R5 = Address of one byte beyond end of destination string
                                ;
                                ; Condition Codes:
                                ;
                                ;       N <- srclen LSS dstlen
                                ;       Z <- srclen EQL dstlen
                                ;       V <- 0
                                ;       C <- srclen LSSU dstlen
                                ;
                                ; Side Effects:
                                ;
                                ;       This routine uses up to four longwords of stack space.
                                ;-
                                ;
                                        .ENABLE LOCAL_BLOCK
                                ;
                                VAX$MOVTC::
54   DD                         PUSHL   R4                      ; Store dstlen on stack
50   DD                         PUSHL   R0                      ; Store srclen on stack
                                ;
                                        ASSUME MOVTC_B_FLAGS EQ 9       ; Insure that FLAGS are in R2<15:8>
                                ;
```

```
                     09 52    08   E0  0004   339          BBS     #<MOVTC_V_FPD+8>,R2,5$  ; Branch if instruction was interrupted
                     02 AE    6E   B0  0008   340          MOVW    (SP),2(SP)              ; Set the initial srclen on stack
                 06 AE    04 AE   B0  000C   341          MOVW    4(SP),6(SP)             ; Set the initial dstlen on stack
                            5A   DD  0011   342 5$:       PUSHL   R10                     ; Save R10 so it can hold handler
                                     0013   343          ESTABLISH_HANDLER       -
                                     0013   344                  STRING_ACCVIO           ; Store address of condition handler
                          54   54   3C  0018   345          MOVZWL  R4,R4                   ; Clear unused bits of dstlen
                               41   13  001B   346          BEQL    40$                     ; All done if zero
                          50   50   3C  001D   347          MOVZWL  R0,R0                   ; Clear unused bits of srclen
                               21   13  0020   348          BEQL    20$                     ; Add fill character to destination
                          55   51   D1  0022   349          CMPL    R1,R5                   ; Check relative position of strings
                               3C   1F  0025   350          BLSSU   MOVE_BACKWARD           ; Perform move from end of strings
                                     0027   351
                                     0027   352 ; This code executes if the source string is at a LARGER virtual address
                                     0027   353 ; than the destination string. The movement takes place from the front
                                     0027   354 ; (small address end) of each string to the back (high address end).
                                     0027   355
                                     0027   356 MOVE_FORWARD:
                            52   DD  0027   357          PUSHL   R2                      ; Allow R2 (fill) to be used as scratch
                          54   50   C2  0029   358          SUBL    R0,R4                   ; Get difference between strings
                               04   1E  002C   359          BGEQU   10$                     ; Branch if fill work to do eventually
                     50   0C AE   3C  002E   360          MOVZWL  12(SP),R0               ; Use dstlen (saved R4) as srclen (R0)
                                     0032   361
                                     0032   362          MARK_POINT      MOVTC_1
                          52   81   9A  0032   363 10$:     MOVZBL  (R1)+,R2                ; Get next character from source
                                     0035   364          MARK_POINT      MOVTC_2
                      85    6342   90  0035   365          MOVB    (R3)[R2],(R5)+          ; Move translated character
                            F6 50   F5  0039   366          SOBGTR  R0,10$                  ; Source all done?
                                     003C   367
                          52   8E   D0  003C   368          MOVL    (SP)+,R2                ; Retrieve fill character from stack
                               54   D5  003F   369          TSTL    R4                      ; Do we need to fill anything?
                               56   15  0041   370          BLEQ    80$                     ; Skip to exit code if no fill work
                                     0043   371
                                     0043   372          MARK_POINT      MOVTC_3
                          85   52   90  0043   373 20$:     MOVB    R2,(R5)+                ; Fill next character
                            FA 54   F5  0046   374          SOBGTR  R4,20$                  ; Destination all done?
                                     0049   375
                                     0049   376 ; This is the common exit path. R2 is cleared to conform to its output
                                     0049   377 ; setting. The condition codes are determined by the original lengths
                                     0049   378 ; of the source and destination strings that were saved on the stack.
                                     0049   379
                               52   D4  0049   380 30$:     CLRL    R2                      ; R2 is zero on return
                          5A   8E   D0  004B   381          MOVL    (SP)+,R10               ; Restore saved R10
                 6E    6E     F0 8F   78  004E   382          ASHL    #-16,(SP),(SP)          ; Get initial srclen
           04 AE    04 AE     F0 8F   78  0053   383          ASHL    #-16,4(SP),4(SP)        ; Get initial dstlen
                          8E   8E   D1  005A   384          CMPL    (SP)+,(SP)+             ; Set condition codes
                               05   05  005D   385          RSB
                                     005E   386
                                     005E   387 ; The following instruction is the exit path when the destination string
                                     005E   388 ; has zero length on input.
                                     005E   389
                          50   50   3C  005E   390 40$:     MOVZWL  R0,R0                   ; Clear unused bits of srclen
                               E6   11  0061   391          BRB     30$                     ; Exit through common code
                                     0063   392
                                     0063   393 ; This code executes if the source string is at a SMALLER virtual address
                                     0063   394 ; than the destination string. The movement takes place from the back
                                     0063   395 ; (high address end) of each string to the front (low address end).
```

```
                     0063   396
                     0063   397 MOVE_BACKWARD:
      55    54   C0  0063   398          ADDL    R4,R5                   ; Point R5 one byte beyond destination
      54    50   C2  0066   399          SUBL    R0,R4                   ; Get amount of fill work to do
            06   1A  0069   400          BGTRU   50$                     ; Branch to fill loop if work to do
 50    08 AE   3C  006B   401          MOVZWL  8(SP),R0                ; Use dstlen (saved R4) as srclen (R0)
            06   11  006F   402          BRB     60$                     ; Skip loop that does fill characters
                     0071   403
                     0071   404          MARK_POINT      MOVTC_4
      75    52   90  0071   405 50$:     MOVB    R2,-(R5)                ; Load fill characters from the back
        FA  54   F5  0074   406          SOBGTR  R4,50$                  ; Continue until excess all done
                     0077   407
      51    50   C0  0077   408 60$:     ADDL    R0,R1                   ; Point R1 to "modified end" of source
                     007A   409
                     007A   410 ; Move transtaled characters from the high-address end toward the low-address
                     007A   411 ; end. Note that the fill character is no longer needed so that R2 is
                     007A   412 ; available as a scratch register.
                     007A   413
                     007A   414          MARK_POINT      MOVTC_5
      52    71   9A  007A   415 70$:     MOVZBL  -(R1),R2                ; Get next character
                     007D   416          MARK_POINT      MOVTC_6
   75    6342   90  007D   417          MOVB    (R3)[R2],-(R5)          ; Move translated character
        F6  50   F5  0081   418          SOBGTR  R0,70$                  ; Continue until source is exhausted
                     0084   419
                     0084   420 ; At this point, R1 points to the first character in the source string and R5
                     0084   421 ; points to the first character in the destination string. This is the result
                     0084   422 ; of operating on the strings from back to front (high-address end to
                     0084   423 ; low-address end). These registers must be modified to point to the ends of
                     0084   424 ; their respective strings. This is accomplished by using the saved original
                     0084   425 ; lengths of the two strings. Note that at this stage of the routine, R2 is
                     0084   426 ; no longer needed and so can be used as a scratch register.
                     0084   427
   52    06 AE   3C  0084   428          MOVZWL  6(SP),R2                ; Get original source length
      51    52   C0  0088   429          ADDL    R2,R1                   ; Point R1 to end of source string
   52    0A AE   3C  008B   430          MOVZWL  10(SP),R2               ; Get original destination length
      55    52   C0  008F   431          ADDL    R2,R5                   ; Point R5 to end of destination string
                     0092   432
                     0092   433 ; If R1 is negative, this indicates that the source string is smaller than the
                     0092   434 ; destination. R1 must be readjusted to point to the first byte that was not
                     0092   435 ; translated. R0, which contains zero, must be loaded with the number of bytes
                     0092   436 ; that were not translated (the negative of the contents of R4).
                     0092   437
            54   D5  0092   438          TSTL    R4                      ; Any more work to do?
            03   13  0094   439          BEQL    30$                     ; Exit through common code
      51    54   C0  0096   440          ADDL    R4,R1                   ; Back up R1 (R4 is negative)
                     0099   441
                     0099   442 ; The exit code for MOVE_FORWARD also comes here if the source is longer than
                     0099   443 ; (or equal to) the destination. Note that in the case of R4 containing zero,
                     0099   444 ; some extra work that accomplishes nothing must be done. This extra work in
                     0099   445 ; the case of equal strings avoids two extra instructions in all cases.
                     0099   446
      50    54   CE  0099   447 80$:     MNEGL   R4,R0                   ; Remaining source length to R0
            54   D4  009C   448          CLRL    R4                      ; R4 is always zero on exit
            A9   11  009E   449          BRB     30$                     ; Exit through common code
                     00A0   450
                     00A0   451          .DISABLE        LOCAL_BLOCK
```

```
00A0   455          .SUBTITLE       VAX$MOVTUC - Move Translated Until Character
00A0   456 ;+
00A0   457 ; Functional Description:
00A0   458 ;
00A0   459 ;       The source string specified by the  source  length  and  source  address
00A0   460 ;       operands  is translated and replaces the destination string specified by
00A0   461 ;       the destination length and destination address operands.  Translation is
00A0   462 ;       accomplished by using each byte of the source string as index into a 256
00A0   463 ;       byte table whose zeroth entry address is specified by the table  address
00A0   464 ;       operand.  The byte selected replaces the byte of the destination string.
00A0   465 ;       Translation continues until a translated byte is  equal  to  the  escape
00A0   466 ;       byte  or until the source string or destination string is exhausted.  If
00A0   467 ;       translation is terminated because of escape the condition code V-bit  is
00A0   468 ;       set;   otherwise  it is cleared.  If the destination string overlaps the
00A0   469 ;       table,  the  destination  string  and  registers  R0  through  R5   are
00A0   470 ;       UNPREDICTABLE.   If the source and destination strings overlap and their
00A0   471 ;       addresses are not identical, the destination  string  and  registers  R0
00A0   472 ;       through  R5  are  UNPREDICTABLE.   If  the source and destination string
00A0   473 ;       addresses are identical, the translation is performed correctly.
00A0   474 ;
00A0   475 ; Input Parameters:
00A0   476 ;
00A0   477 ;       The following register fields contain the same information that
00A0   478 ;       exists in the operands to the MOVTUC instruction.
00A0   479 ;
00A0   480 ;               R0<15:0> = srclen       Length of source string
00A0   481 ;               R1       = srcaddr      Address of source string
00A0   482 ;               R2<7:0>  = fill         Escape character
00A0   483 ;               R3       = tbladdr      Address of 256-byte table
00A0   484 ;               R4<15:0> = dstlen       Length of destination string
00A0   485 ;               R5       = dstaddr      Address of destination string
00A0   486 ;
00A0   487 ;       In addition to the input parameters that correspond directly to
00A0   488 ;       operands to the MOVTUC instruction, there are other input parameters
00A0   489 ;       to this routine. Note that the two inixxxlen parameters are only
00A0   490 ;       used when the MOVTUC_V_FPD bit is set in the FLAGS byte.
00A0   491 ;
00A0   492 ;               R2<15:8>  = FLAGS       Instruction-specific status
00A0   493 ;
00A0   494 ;       The contents of the FLAGS byte must be zero (MBZ) on entry to this
00A0   495 ;       routine from the outside world (through the emulator jacket or by
00A0   496 ;       a JSB call). If the initial contents of FLAGS are not zero, the
00A0   497 ;       actions of this routine are UNPREDICTABLE.
00A0   498 ;
00A0   499 ;       There are two other input parameters whose contents depend on
00A0   500 ;       the settings of the FLAGS byte.
00A0   501 ;
00A0   502 ;       MOVTUC_V_FPD bit in FLAGS is CLEAR
00A0   503 ;
00A0   504 ;               R0<31:16> = IRRELEVANT
00A0   505 ;               R4<31:16> = IRRELEVANT
00A0   506 ;
00A0   507 ;       MOVTUC_V_FPD bit in FLAGS is SET
00A0   508 ;
00A0   509 ;               R0<31:16> = inisrclen   Initial length of source string
00A0   510 ;               R4<31:16> = inidstlen   Initial length of destination string
00A0   511 ;
```

```
;  Intermediate State:
;
;       31              23              15              07              00
;      +---------------+---------------+---------------+---------------+
;      |        initial srclen         |             srclen            | : R0
;      +---------------+---------------+---------------+---------------+
;      |                             srcaddr                           | : R1
;      +---------------+---------------+---------------+---------------+
;      |   delta-PC    |     XXXX      |     FLAGS     |      esc      | : R2
;      +---------------+---------------+---------------+---------------+
;      |                             tbladdr                           | : R3
;      +---------------+---------------+---------------+---------------+
;      |        initial dstlen         |             dstlen            | : R4
;      +---------------+---------------+---------------+---------------+
;      |                             dstaddr                           | : R5
;      +---------------+---------------+---------------+---------------+
;
;  Output Parameters:
;
;       The final state of this instruction (routine) can exist in one of
;       three forms, depending on the relative lengths of the source and
;       destination strings and whether a translated character matched the
;       escape character.
;
;    1. Some byte matched escape character
;
;               R0 = Number of bytes remaining in the source string (including
;                    the byte that caused the escape)
;               R1 = Address of the byte that caused the escape
;               R2 = 0
;               R3 = tbladdr    Address of 256-byte table
;               R4 = Number of bytes remaining in the destination string
;               R5 = Address of byte that would have received the translated byte
;
;    2. Destination string exhausted
;
;               R0 = Number of bytes remaining in the source string
;               R1 = Address of the byte that resulted in exhaustion
;               R2 = 0
;               R3 = tbladdr    Address of 256-byte table
;               R4 = 0 (Number of bytes remaining in the destination string)
;               R5 = Address of one byte beyond end of destination string
;
;    3. Source string exhausted
;
;               R0 = 0 (Number of bytes remaining in the source string)
;               R5 = Address of one byte beyond end of source string
;               R2 = 0
;               R3 = tbladdr    Address of 256-byte table
;               R4 = Number of bytes remaining in the destination string
;               R5 = Address of byte that would have received the translated byte
;
;  Condition Codes:
;
;       N <- srclen LSS dstlen
;       Z <- srclen EQL dstlen
;       V <- set if terminated by escape
```

```
                                00A0   569 ;       C <- srclen LSSU dstlen
                                00A0   570 ;
                                00A0   571 ; Side Effects:
                                00A0   572 ;
                                00A0   573 ;       This routine uses five longwords of stack.
                                00A0   574 ;-
                                00A0   575
                                00A0   576         .ENABLE LOCAL_BLOCK
                                00A0   577
                                00A0   578 VAX$MOVTUC::
                          54    DD    00A0   579         PUSHL   R4                      ; Store dstlen on stack
                          50    DD    00A2   580         PUSHL   R0                      ; Store srclen on stack
                                00A4   581
                                00A4   582         ASSUME MOVTUC_B_FLAGS EQ 9      ; Insure that FLAGS are in R2<15:8>
                                00A4   583
                    09 52     08    E0    00A4   584         BBS     #<MOVTUC_V_FPD+8>,R2,5$ ; Branch if instruction was interrupted
                    02 AE     6E    B0    00A8   585         MOVW    (SP),2(SP)              ; Set the initial srclen on stack
                06 AE    04 AE    B0    00AC   586         MOVW    4(SP),6(SP)             ; Set the initial dstlen on stack
                       54    54    3C    00B1   587 5$:      MOVZWL  R4,R4                   ; Clear unused bits of dstlen
                             4F    13    00B4   588         BEQL    50$                     ; Almost done if zero length
                       50    50    3C    00B6   589         MOVZWL  R0,R0                   ; Clear unused bits of srclen
                             38    13    00B9   590         BEQL    40$                     ; Done if zero length
                             5A    DD    00BB   591         PUSHL   R10                     ; Save R10 so it can hold handler
                                   00BD   592         ESTABLISH_HANDLER       -
                                   00BD   593                 STRING_ACCVIO           ; Store address of condition handler
                             57    DD    00C2   594         PUSHL   R7                      ; We need some scratch registers
                             56    DD    00C4   595         PUSHL   R6                      ;
                                   00C6   596
                                   00C6   597 ; Note that all code must now exit through a code path that restores R6
                                   00C6   598 ; R7, and R10 to insure that the stack is correctly aligned and that these
                                   00C6   599 ; register contents are preserved across execution of this routine.
                                   00C6   600
                                   00C6   601 ; The following initialization routine is designed to make the main loop
                                   00C6   602 ; execute faster. It performs three actions.
                                   00C6   603 ;
                                   00C6   604 ;       R7 <- Smaller of R0 and R4 (srclen and dstlen)
                                   00C6   605 ;
                                   00C6   606 ;       Larger of R0 and R4 is replaced by the difference between R0 and R4.
                                   00C6   607 ;
                                   00C6   608 ;       Smaller of R0 and R4 is replaced by zero.
                                   00C6   609 ;
                                   00C6   610 ; This initializes R0 and R4 to their final states if either the source
                                   00C6   611 ; string or the destination string is exhausted. In the event that the loop
                                   00C6   612 ; is terminated through the escape path, these two registers are readjusted
                                   00C6   613 ; to contain the proper values as if they had each been advanced one byte
                                   00C6   614 ; for each trip through the loop.
                                   00C6   615
                          54    50    C2    00C6   616         SUBL    R0,R4                   ; Replace R4 with (R4-R0)
                                07    1F    00C9   617         BLSSU   10$                     ; Branch if srclen GTRU dstlen
                                   00CB   618
                                   00CB   619 ; Code path for srclen (R0) LEQU dstlen (R4). R4 is already correctly loaded.
                                   00CB   620
                          57    50    D0    00CB   621         MOVL    R0,R7                   ; Load R7 with smaller (R0)
                                50    D4    00CE   622         CLRL    R0                      ; Load smaller (R0) with zero
                                09    11    00D0   623         BRB     20$                     ; Merge with common code at top of loop
                                   00D2   624
                                   00D2   625 ; Code path for srclen (R0) GTRU dstlen (R4).
```

```
                                00D2    626
                     57   10 AE  3C   00D2    627 10$:    MOVZWL  16(SP),R7                ; Load R7 with smaller (use saved R4)
                          50  54  CE   00D6    628         MNEGL   R4,R0                    ; Load larger (R0) with ABS(R4-R0)
                              54  D4   00D9    629         CLRL    R4                       ; Load smaller (R4) with zero
                                      00DB    630
                                      00DB    631 ; The following is the main loop in this routine.
                                      00DB    632
                                      00DB    633         MARK_POINT      MOVTUC_1
                          56  81  9A   00DB    634 20$:    MOVZBL  (R1)+,R6                 ; Get next character from source string
                                      00DE    635         MARK_POINT      MOVTUC_2
                       56   6346  9A   00DE    636         MOVZBL  (R3)[R6],R6              ; Convert to translated character
                          56  52  91   00E2    637         CMPB    R2,R6                    ; Does it match escape character?
                              23  13   00E5    638         BEQL    ESCAPE                   ; Exit loop if yes
                                      00E7    639         MARK_POINT      MOVTUC_3
                          85  56  90   00E7    640         MOVB    R6,(R5)+                 ; Move translated character to
                                      00EA    641                                          ;  destination string
                            EE 57  F5   00EA    642         SOBGTR  R7,20$                   ; Shorter string exhausted?
                                      00ED    643
                                      00ED    644 ; The following exit path is taken when the shorter of the source string and
                                      00ED    645 ; the destination string is exhausted
                                      00ED    646
                          56  8E  7D   00ED    647 30$:    MOVQ    (SP)+,R6                 ; Restore contents of scratch register
                          5A  8E  D0   00F0    648         MOVL    (SP)+,R10                ; Restore saved R10
                              52  D4   00F3    649 40$:    CLRL    R2                       ; R2 must be zero on output
                   6E     6E   F0 8F   78   00F5    650         ASHL    #-16,(SP),(SP)           ; Get initial srclen
                04 AE  04 AE   F0 8F   78   00FA    651         ASHL    #-16,4(SP),4(SP)         ; Get initial dstlen
                          8E  8E  D1   0101    652         CMPL    (SP)+,(SP)+              ; Set condition codes (V-bit always 0)
                              05  0104    653         RSB                              ; Return
                                      0105    654
                                      0105    655 ; This code executes if the destination string has zero length. The source
                                      0105    656 ; length is set to a known state so that the common exit path can be taken.
                                      0105    657
                          50  50  3C   0105    658 50$:    MOVZWL  R0,R0                    ; Clear unused bits of srclen
                              E9  11   0108    659         BRB     40$                      ; Exit through common code
                                      010A    660
                                      010A    661 ; This code executes if the escape character matches the entry in the
                                      010A    662 ; 256-byte table indexed by the character in the source string. Registers
                                      010A    663 ; R0 and R4 must be adjusted to indicate that neither string was exhausted.
                                      010A    664 ; The last step taken before return sets the V-bit.
                                      010A    665
                                      010A    666 ESCAPE:
                              51  D7   010A    667         DECL    R1                       ; Reset R1 to correct byte in source
                              52  D4   010C    668         CLRL    R2                       ; R2 must be zero on output
                          50  57  C0   010E    669         ADDL    R7,R0                    ; Adjust saved srclen
                          54  57  C0   0111    670         ADDL    R7,R4                    ; Adjust saved dstlen
                          56  8E  7D   0114    671         MOVQ    (SP)+,R6                 ; Restore contents of scratch registers
                          5A  8E  D0   0117    672         MOVL    (SP)+,R10                ; Restore saved R10
                   6E     6E   F0 8F   78   011A    673         ASHL    #-16,(SP),(SP)           ; Get initial srclen
                04 AE  04 AE   F0 8F   78   011F    674         ASHL    #-16,4(SP),4(SP)         ; Get initial dstlen
                          8E  8E  D1   0126    675         CMPL    (SP)+,(SP)+              ; Set condition codes (V-bit always 0)
                              02  B8   0129    676         BISPSW  #PSL$M_V                 ; Set V-bit to indicate ESCAPE
                              05  012B    677         RSB                              ; Return
                                      012C    678
                                      012C    679         .DISABLE        LOCAL_BLOCK
```

```
012C    683          .SUBTITLE       VAX$CMPC3 - Compare Characters (3 Operand)
012C    684 ;+
012C    685 ; Functional Description:
012C    686 ;
012C    687 ;       The bytes of string 1 specified by the length and address 1 operands are
012C    688 ;       compared  with the bytes of string 2 specified by the length and address
012C    689 ;       2 operands.  Comparison proceeds until inequality is detected or all the
012C    690 ;       bytes  of  the strings have been examined.  Condition codes are affected
012C    691 ;       by the result of the last byte  comparison.   Two  zero  length  strings
012C    692 ;       compare equal (i.e.  Z is set and N, V, and C are cleared).
012C    693 ;
012C    694 ; Input Parameters:
012C    695 ;
012C    696 ;       R0<15:0> = len          Length of character strings
012C    697 ;       R1       = src1addr     Address of first character string (called S1)
012C    698 ;       R3       = src2addr     Address of second character string (called S2)
012C    699 ;
012C    700 ; Intermediate State:
012C    701 ;
012C    702 ;        31               23               15               07               00
012C    703 ;       +----------------+----------------+----------------+----------------+
012C    704 ;       |    delta-PC    |      XXXX      |                len               | : R0
012C    705 ;       +----------------+----------------+----------------+----------------+
012C    706 ;       |                                src1addr                            | : R1
012C    707 ;       +----------------+----------------+----------------+----------------+
012C    708 ;       |                                XXXXX                               | : R2
012C    709 ;       +----------------+----------------+----------------+----------------+
012C    710 ;       |                                src2addr                            | : R3
012C    711 ;       +----------------+----------------+----------------+----------------+
012C    712 ;
012C    713 ; Output Parameters:
012C    714 ;
012C    715 ;       Strings are IDENTICAL
012C    716 ;
012C    717 ;               R0 = 0
012C    718 ;               R1 = Address of one byte beyond end of S1
012C    719 ;               R2 = 0 (same as R0)
012C    720 ;               R1 = Address of one byte beyond end of S2
012C    721 ;
012C    722 ;       Strings DO NOT MATCH
012C    723 ;
012C    724 ;               R0 = Number of bytes left in strings (including first byte
012C    725 ;                    that did not match)
012C    726 ;               R1 = Address of nonmatching byte in S1
012C    727 ;               R2 = R0
012C    728 ;               R3 = Address of nonmatching byte in S2
012C    729 ;
012C    730 ; Condition Codes:
012C    731 ;
012C    732 ;       In general, the condition codes reflect whether or not the strings
012C    733 ;       are considered the same or different. In the case of different
012C    734 ;       strings, the condition codes reflect the result of the comparison
012C    735 ;       that indicated that the strings are not equal.
012C    736 ;
012C    737 ;       Strings are IDENTICAL
012C    738 ;
012C    739 ;               N <- 0
```

```
                     012C   740 ;                  Z <- 1                          ; (byte in S1) EQL (byte in S2)
                     012C   741 ;                  V <- 0
                     012C   742 ;                  C <- 0
                     012C   743 ;
                     012C   744 ;          Strings DO NOT MATCH
                     012C   745 ;
                     012C   746 ;                  N <- (byte in S1) LSS (byte in S2)
                     012C   747 ;                  Z <- 0                          ; (byte in S1) NEQ (byte in S2)
                     012C   748 ;                  V <- 0
                     012C   749 ;                  C <- (byte in S1) LSSU (byte in S2)
                     012C   750 ;
                     012C   751 ;          where "byte in S1" or "byte in S2" may indicate the fill character
                     012C   752 ;
                     012C   753 ; Side Effects:
                     012C   754 ;
                     012C   755 ;          This routine uses one longword of stack.
                     012C   756 ;-
                     012C   757
                     012C   758 VAX$CMPC3::
50   50   3C   012C   759          MOVZWL  R0,R0                           ; Clear unused bits & check for zero
     12   13   012F   760          BEQL    20$                             ; Simply return if zero length string
                     0131   761
     5A   DD   0131   762          PUSHL   R10                             ; Save R10 so it can hold handler
                     0133   763          ESTABLISH_HANDLER       -
                     0133   764                  STRING_ACCVIO           ; Store address of condition handler
                     0138   765
                     0138   766          MARK_POINT      CMPC3_1
81   83   91   0138   767 10$:     CMPB    (R3)+,(R1)+                     ; Character match?
     0B   12   013B   768          BNEQ    30$                             ; Exit loop if different
   F8 50   F5   013D   769          SOBGTR  R0,10$
                     0140   770
                     0140   771 ; Exit path for strings IDENTICAL (R0 = 0, either on input or after loop)
                     0140   772
5A   8E   D0   0140   773          MOVL    (SP)+,R10                       ; Restore saved R10
     52   D4   0143   774 20$:     CLRL    R2                              ; Set R2 for output value of 0
     50   D5   0145   775          TSTL    R0                              ; Set condition codes
          05   0147   776          RSB                                     ; Return point for IDENTICAL strings
                     0148   777
                     0148   778 ; Exit path when strings DO NOT MATCH
                     0148   779
5A   8E   D0   0148   780 30$:     MOVL    (SP)+,R10                       ; Restore saved R10
52   50   D0   014B   781          MOVL    R0,R2                           ; R0 and R2 are the same on exit
73   71   91   014E   782          CMPB    -(R1),-(R3)                     ; Reset R1 and R3 and set condition codes
          05   0151   783          RSB                                     ; Return point when strings DO NOT MATCH
```

```
0152   787          .SUBTITLE       VAX$CMPC5 - Compare Characters (5 Operand)
0152   788 ;+
0152   789 ; Functional Description:
0152   790 ;
0152   791 ;       The bytes of the string 1 specified  by  the  length  1  and  address  1
0152   792 ;       operands  are  compared  with the bytes of the string 2 specified by the
0152   793 ;       length 2 and address 2 operands.  If  one  string  is  longer  than  the
0152   794 ;       other,  the shorter string is conceptually extended to the length of the
0152   795 ;       longer by appending (at  higher  addresses)  bytes  equal  to  the  fill
0152   796 ;       operand.   Comparison  proceeds  until inequality is detected or all the
0152   797 ;       bytes of the strings have been examined.  Condition codes  are  affected
0152   798 ;       by  the  result  of  the  last byte comparison.  Two zero length strings
0152   799 ;       compare equal (i.e.  Z is set and N, V, and C are cleared).
0152   800 ;
0152   801 ; Input Parameters:
0152   802 ;
0152   803 ;       R0<15:0>  = len         Length of first character string (called S1)
0152   804 ;       R0<23:16> = fill        Fill character that is used when strings have
0152   805 ;                                 different lengths
0152   806 ;       R1        = addr        Address of first character string
0152   807 ;       R2<15:0>  = len         Length of second character string (called S2)
0152   808 ;       R3        = addr        Address of second character string
0152   809 ;
0152   810 ; Intermediate State:
0152   811 ;
0152   812 ;        31              23              15              07              00
0152   813 ;       +---------------+---------------+---------------+---------------+
0152   814 ;       |    delta-PC   |      fill     |            src1len            | : R0
0152   815 ;       +---------------+---------------+---------------+---------------+
0152   816 ;       |                           src1addr                            | : R1
0152   817 ;       +---------------+---------------+---------------+---------------+
0152   818 ;       |               XXXXX           |            src2len            | : R2
0152   819 ;       +---------------+---------------+---------------+---------------+
0152   820 ;       |                           src2addr                            | : R3
0152   821 ;       +---------------+---------------+---------------+---------------+
0152   822 ;
0152   823 ; Output Parameters:
0152   824 ;
0152   825 ;       Strings are IDENTICAL
0152   826 ;
0152   827 ;               R0 = 0
0152   828 ;               R1 = Address of one byte beyond end of S1
0152   829 ;               R2 = 0 (same as R0)
0152   830 ;               R1 = Address of one byte beyond end of S2
0152   831 ;
0152   832 ;       Strings DO NOT MATCH
0152   833 ;
0152   834 ;               R0 = Number of bytes remaining in S1 when mismatch detected
0152   835 ;                    (or zero if S1 exhausted before mismatch detected)
0152   836 ;               R1 = Address of nonmatching byte in S1
0152   837 ;               R2 = Number of bytes remaining in S2 when mismatch detected
0152   838 ;                    (or zero if S2 exhausted before mismatch detected)
0152   839 ;               R3 = Address of nonmatching byte in S2
0152   840 ;
0152   841 ; Condition Codes:
0152   842 ;
0152   843 ;       In general, the condition codes reflect whether or not the strings
```

```
                     0152   844 ;       are considered the same or different. In the case of different
                     0152   845 ;       strings, the condition codes reflect the result of the comparison
                     0152   846 ;       that indicated that the strings are not equal.
                     0152   847 ;
                     0152   848 ;       Strings are IDENTICAL
                     0152   849 ;
                     0152   850 ;               N <- 0
                     0152   851 ;               Z <- 1                  ; (byte in S1) EQL (byte in S2)
                     0152   852 ;               V <- 0
                     0152   853 ;               C <- 0
                     0152   854 ;
                     0152   855 ;       Strings DO NOT MATCH
                     0152   856 ;
                     0152   857 ;               N <- (byte in S1) LSS (byte in S2)
                     0152   858 ;               Z <- 0                  ; (byte in S1) NEQ (byte in S2)
                     0152   859 ;               V <- 0
                     0152   860 ;               C <- (byte in S1) LSSU (byte in S2)
                     0152   861 ;
                     0152   862 ;       where "byte in S1" or "byte in S2" may indicate the fill character
                     0152   863 ;
                     0152   864 ; Side Effects:
                     0152   865 ;
                     0152   866 ;       This routine uses two longwords of stack.
                     0152   867 ;-
                     0152   868
                     0152   869         .ENABLE LOCAL_BLOCK
                     0152   870
                     0152   871 VAX$CMPC5::
                5A   DD   0152   872         PUSHL   R10                     ; Save R10 so it can hold handler
                     0154   873         ESTABLISH_HANDLER       -
                     0154   874                 STRING_ACCVIO           ; Store address of condition handler
                54   DD   0159   875         PUSHL   R4                      ; Save register
          54    50   F0 8F   78   015B   876         ASHL    #-16,R0,R4              ; Get escape character
                50   50   3C   0160   877         MOVZWL  R0,R0                   ; Clear unused bits & is S1 length zero?
                     28   13   0163   878         BEQL    50$                     ; Branch if yes
                52   52   3C   0165   879         MOVZWL  R2,R2                   ; Clear unused bits & is S2 length zero?
                     14   13   0168   880         BEQL    30$
                          016A   881
                          016A   882 ; Main loop. The following loop executes when both strings have characters
                          016A   883 ; remaining and inequality has not yet been detected.
                          016A   884
                          016A   885 ; THE FOLLOWING LOOP IS A TARGET FOR FURTHER OPTIMIZATION IN THAT THE
                          016A   886 ; LOOP SHOULD NOT REQUIRE TWO SOBGTR INSTRUCTIONS. NOTE, THOUGH, THAT
                          016A   887 ; THE CURRENT UNOPTIMIZED LOOP IS EASIER TO BACK UP.
                          016A   888
                          016A   889         MARK_POINT      CMPC5_1
                83   81   91   016A   890 10$:    CMPB    (R1)+,(R3)+             ; Characters match?
                     32   12   016D   891         BNEQ    80$                     ; Exit loop if bytes different
                  09 50   F5   016F   892         SOBGTR  R0,20$                  ; Check for S1 exhausted
                          0172   893
                          0172   894 ; The next test determines whether S2 is also exhausted.
                          0172   895
                52   D7   0172   896         DECL    R2                      ; Put R2 in step with R0
                     1C   12   0174   897         BNEQ    60$                     ; Branch if bytes remaining in S2
                          0176   898
                          0176   899 ; This is the exit path for identical strings. If we get here, then both
                          0176   900 ; R0 and R2 are zero.  The condition codes are correctly set (by the ASHL
```

```
                     0176   901 ; instruction) so the registers are restored with a POPR to avoid changing
                     0176   902 ; the condition codes.
                     0176   903
                     0176   904 IDENTICAL:
0410 8F      BA      0176   905         POPR    #^M<R4,R10>                 ; Restore saved registers
             05      017A   906         RSB                                 ; Exit indicating IDENTICAL strings
                     017B   907
  EC 52      F5      017B   908 20$:    SOBGTR  R2,10$                      ; Check for S2 exhausted
                     017E   909
                     017E   910 ; The following loop is entered when all of S2 has been processed but
                     017E   911 ; there are characters remaining in S1. In other words,
                     017E   912 ;
                     017E   913 ;       R0 GTRU 0
                     017E   914 ;       R2 EQL 0
                     017E   915 ;
                     017E   916 ; The remaining characters in S1 are compared to the fill character.
                     017E   917
                     017E   918         MARK_POINT      CMPC5_2
54   81      91      017E   919 30$:    CMPB    (R1)+,R4                    ; Characters match?
     05      12      0181   920         BNEQ    40$                         ; Exit loop if no match
  F8 50      F5      0183   921         SOBGTR  R0,30$                      ; Any more bytes in S1?
                     0186   922
     EE      11      0186   923         BRB     IDENTICAL                   ; Exit indicating IDENTICAL strings
                     0188   924
54   71      91      0188   925 40$:    CMPB    -(R1),R4                    ; Reset R1 and set condition codes
     17      11      018B   926         BRB     NO_MATCH                    ; Exit indicating strings DO NOT MATCH
                     018D   927
                     018D   928 ; The following code executes if S1 has zero length on input. If S2 also
                     018D   929 ; has zero length, the routine smply returns, indicating equal strings.
                     018D   930
52   52      3C      018D   931 50$:    MOVZWL  R2,R2                       ; Clear unused bits. Is S2 len also zero?
     E4      13      0190   932         BEQL    IDENTICAL                   ; Exit indicating IDENTICAL strings
                     0192   933
                     0192   934 ; The following loop is entered when all of S1 has been processed but
                     0192   935 ; there are characters remaining in S2. In other words,
                     0192   936 ;
                     0192   937 ;       R0 EQL 0
                     0192   938 ;       R2 GTRU 0
                     0192   939 ;
                     0192   940 ; The remaining characters in S2 are compared to the fill character.
                     0192   941
                     0192   942         MARK_POINT      CMPC5_3
83   54      91      0192   943 60$:    CMPB    R4,(R3)+                    ; Characters match?
     05      12      0195   944         BNEQ    70$                         ; Exit loop if no match
  F8 52      F5      0197   945         SOBGTR  R2,60$                      ; Any more bytes in S2?
                     019A   946
     DA      11      019A   947         BRB     IDENTICAL                   ; Exit indicating IDENTICAL strings
                     019C   948
73   54      91      019C   949 70$:    CMPB    R4,-(R3)                    ; Reset R3 and set condition codes
     03      11      019F   950         BRB     NO_MATCH                    ; Exit indicating strings DO NOT MATCH
                     01A1   951
                     01A1   952 ; The following exit path is taken if both strings have characters
                     01A1   953 ; remaining and a character pair that did not match was detected.
                     01A1   954
73   71      91      01A1   955 80$:    CMPB    -(R1),-(R3)                 ; Reset R1 and R3 and set condition codes
                     01A4   956 NO_MATCH:                                   ; Restore R4 and R10
0410 8F      BA      01A4   957         POPR    #^M<R4,R10>                 ;  without changing condition codes
```

```
 05  01A8   958          RSB                             ; Exit indicating strings DO NOT MATCH
     01A9   959
     01A9   960          .DISABLE        LOCAL_BLOCK
```

```
                                .SUBTITLE       VAX$SCANC - Scan Characters
                        ;+
                        ; Functional Description:
                        ;
                        ;       The bytes of the string specified by the length and address operands are
                        ;       successively  used  to  index  into  a 256 byte table whose zeroth entry
                        ;       address is specified by the table address operand.   The  byte  selected
                        ;       from  the table is ANDed with the mask operand.  The operation continues
                        ;       until the result of the AND is non-zero or all the bytes of  the  string
                        ;       have  been  exhausted.   If  a  non-zero  AND  result  is  detected, the
                        ;       condition code Z-bit is cleared;  otherwise, the Z-bit is set.
                        ;
                        ; Input Parameters:
                        ;
                        ;       R0<15:0> = len          Length of character string
                        ;       R1       = addr         Address of character string
                        ;       R2<7:0>  = mask         Mask that is ANDed with successive characters
                        ;       R3       = tbladdr      Address of 256-byte table
                        ;
                        ; Intermediate State:
                        ;
                        ;    31                 23                 15                 07                 00
                        ;   +------------------+------------------+------------------+------------------+
                        ;   |    delta-PC      |       XXXX       |                  len                 | : R0
                        ;   +------------------+------------------+------------------+------------------+
                        ;   |                                     addr                                   | : R1
                        ;   +------------------+------------------+------------------+------------------+
                        ;   |                XXXXX                |       XXXX       |       mask       | : R2
                        ;   +------------------+------------------+------------------+------------------+
                        ;   |                                    tbladdr                                 | : R3
                        ;   +------------------+------------------+------------------+------------------+
                        ;
                        ; Output Parameters:
                        ;
                        ;       NONZERO AND result
                        ;
                        ;               R0 = Number of bytes remaining in the string (including the byte
                        ;                    that produced the NONZERO AND result)
                        ;               R1 = Address of the byte that produced the NONZERO AND result
                        ;               R2 = 0
                        ;               R3 = tbladdr    Address of 256-byte table
                        ;
                        ;       AND result always ZERO (string exhausted)
                        ;
                        ;               R0 = 0
                        ;               R1 = Address of one byte beyond end of string
                        ;               R2 = 0
                        ;               R3 = tbladdr    Address of 256-byte table
                        ;
                        ; Condition Codes:
                        ;
                        ;       N <- 0
                        ;       Z <- R0 EQL 0
                        ;       V <- 0
                        ;       C <- 0
                        ;
                        ;       The Z bit is clear if there was a NONZERO AND result.
```

```
                     01A9  1021 ;       The Z bit is set if the input string is exhausted.
                     01A9  1022 ;
                     01A9  1023 ; Side Effects:
                     01A9  1024 ;
                     01A9  1025 ;       This routine uses two longwords of stack.
                     01A9  1026 ;-
                     01A9  1027
                     01A9  1028 VAX$SCANC::
          50   50    3C  01A9  1029          MOVZWL  R0,R0                   ; Zero length string?
               19    13  01AC  1030          BEQL    30$                     ; Simply return if yes
               5A    DD  01AE  1031          PUSHL   R10                     ; Save R10 so it can hold handler
                         01B0  1032          ESTABLISH_HANDLER       -
                         01B0  1033                  STRING_ACCVIO           ; Store address of condition handler
               54    DD  01B5  1034          PUSHL   R4                      ; We need a scratch register
                         01B7  1035
                         01B7  1036          MARK_POINT      SCANC_1
          54   81    9A  01B7  1037 10$:     MOVZBL  (R1)+,R4                ; Get next character in string
                         01BA  1038          MARK_POINT      SCANC_2
        6344   52    93  01BA  1039          BITB    R2,(R3)[R4]             ; Index into table and AND with mask
               0C    12  01BE  1040          BNEQ    40$                     ; Exit loop if NONZERO
             F4 50   F5  01C0  1041          SOBGTR  R0,10$
                         01C3  1042
                     01C3  1043 ; If we drop through the end of the loop into the following code, then
                     01C3  1044 ; the input string was exhausted with no NONZERO result.
                     01C3  1045
          0410 8F    BA  01C3  1046 20$:     POPR    #^M<R4,R10>             ; Restore saved registers
               52    D4  01C7  1047 30$:     CLRL    R2                      ; Set R2 for output value of 0
               50    D5  01C9  1048          TSTL    R0                      ; Set condition codes
                     05  01CB  1049          RSB                             ; Return
                         01CC  1050
                     01CC  1051 ; Exit path from loop if AND produced NONZERO result
                     01CC  1052
          51   D7    01CC  1053 40$:     DECL    R1                      ; Point R1 to located character
          F3   11    01CE  1054          BRB     20$                     ; Merge with common exit
```

```
01D0  1058          .SUBTITLE       VAX$SPANC - Span Characters
01D0  1059 ;+
01D0  1060 ; Functional Description:
01D0  1061 ;
01D0  1062 ;       The bytes of the string specified by the length and address operands are
01D0  1063 ;       successively  used  to  index  into  a 256 byte table whose zeroth entry
01D0  1064 ;       address is specified by the table address operand.   The  byte  selected
01D0  1065 ;       from  the table is ANDed with the mask operand.  The operation continues
01D0  1066 ;       until the result of the AND is zero or all the bytes of the string  have
01D0  1067 ;       been  exhausted.   If  a zero AND result is detected, the condition code
01D0  1068 ;       Z-bit is cleared;  otherwise, the Z-bit is set.
01D0  1069 ;
01D0  1070 ; Input Parameters:
01D0  1071 ;
01D0  1072 ;       R0<15:0> = len          Length of character string
01D0  1073 ;       R1       = addr         Address of character string
01D0  1074 ;       R2<7:0>  = mask         Mask that is ANDed with successive characters
01D0  1075 ;       R3       = tbladdr      Address of 256-byte table
01D0  1076 ;
01D0  1077 ; Intermediate State:
01D0  1078 ;
01D0  1079 ;     31               23               15               07              00
01D0  1080 ;    +----------------+----------------+----------------+----------------+
01D0  1081 ;    !    delta-PC    !      XXXX      !                len               ! : R0
01D0  1082 ;    +----------------+----------------+----------------+----------------+
01D0  1083 ;    !                                addr                               ! : R1
01D0  1084 ;    +----------------+----------------+----------------+----------------+
01D0  1085 ;    !             XXXXX              !      XXXX      !      mask      ! : R2
01D0  1086 ;    +----------------+----------------+----------------+----------------+
01D0  1087 ;    !                              tbladdr                              ! : R3
01D0  1088 ;    +----------------+----------------+----------------+----------------+
01D0  1089 ;
01D0  1090 ; Output Parameters:
01D0  1091 ;
01D0  1092 ;       ZERO AND result
01D0  1093 ;
01D0  1094 ;               R0 = Number of bytes remaining in the string (including the byte
01D0  1095 ;                    that produced the ZERO AND result)
01D0  1096 ;               R1 = Address of the byte that produced the ZERO AND result
01D0  1097 ;               R2 = 0
01D0  1098 ;               R3 = tbladdr    Address of 256-byte table
01D0  1099 ;
01D0  1100 ;       AND result always NONZERO (string exhausted)
01D0  1101 ;
01D0  1102 ;               R0 = 0
01D0  1103 ;               R1 = Address of one byte beyond end of string
01D0  1104 ;               R2 = 0
01D0  1105 ;               R3 = tbladdr    Address of 256-byte table
01D0  1106 ;
01D0  1107 ; Condition Codes:
01D0  1108 ;
01D0  1109 ;       N <- 0
01D0  1110 ;       Z <- R0 EQL 0
01D0  1111 ;       V <- 0
01D0  1112 ;       C <- 0
01D0  1113 ;
01D0  1114 ;       The Z bit is clear if there was a ZERO AND result.
```

```
                     01D0  1115 ;       The Z bit is set if the input string is exhausted.
                     01D0  1116 ;
                     01D0  1117 ; Side Effects:
                     01D0  1118 ;
                     01D0  1119 ;       This routine uses two longwords of stack.
                     01D0  1120 ;-
                     01D0  1121
                     01D0  1122 VAX$SPANC::
          50   50    3C 01D0  1123          MOVZWL  R0,R0                   ; Clear unused bits & check for 0 length
               19    13 01D3  1124          BEQL    30$                     ; Simply return if length is zero
               5A    DD 01D5  1125          PUSHL   R10                     ; Save R10 so it can hold handler
                        01D7  1126          ESTABLISH_HANDLER       -
                        01D7  1127                  STRING_ACCVIO           ; Store address of condition handler
               54    DD 01DC  1128          PUSHL   R4                      ; We need a scratch register
                        01DE  1129
                        01DE  1130          MARK_POINT      SPANC_1
          54   81    9A 01DE  1131 10$:     MOVZBL  (R1)+,R4                ; Get next character in string
                        01E1  1132          MARK_POINT      SPANC_2
        6344   52    93 01E1  1133          BITB    R2,(R3)[R4]             ; Index into table and AND with mask
               0C    13 01E5  1134          BEQL    40$                     ; Exit loop if NONZERO
             F4 50   F5 01E7  1135          SOBGTR  R0,10$
                        01EA  1136
                        01EA  1137 ; If we drop through the end of the loop into the following code, then
                        01EA  1138 ; the input string was exhausted with no ZERO result.
                        01EA  1139
          0410 8F   BA 01EA  1140 20$:     POPR    #^M<R4,R10>             ; Restore saved registers
               52   D4 01EE  1141 30$:     CLRL    R2                      ; Set R2 for output value of 0
               50   D5 01F0  1142          TSTL    R0                      ; Set condition codes
                    05 01F2  1143          RSB                             ; Return
                        01F3  1144
                        01F3  1145 ; Exit path from loop if AND produced ZERO result
                        01F3  1146
          51   D7    01F3  1147 40$:     DECL    R1                      ; Point R1 to located character
          F3   11    01F5  1148          BRB     20$                     ; Merge with common exit
```

```
                        .SUBTITLE       VAX$LOCC - Locate Character
                ;+
                ; Functional Description:
                ;
                ;       The character operand is compared with the bytes of the string specified
                ;       by the length and address operands.  Comparison continues until equality
                ;       is detected or all bytes of the string have been compared.  If  equality
                ;       is  detected;  the condition code Z-bit is cleared;  otherwise the Z-bit
                ;       is set.
                ;
                ; Input Parameters:
                ;
                ;       R0<15:0>  = len         Length of character string
                ;       R0<23:16> = char        Character to be located
                ;       R1        = addr        Address of character string
                ;
                ; Intermediate State:
                ;
                ;    31                23                15                07                00
                ;   +-----------------+-----------------+-----------------+-----------------+
                ;   |    delta-PC     |      char       |                 len               | : R0
                ;   +-----------------+-----------------+-----------------+-----------------+
                ;   |                                   addr                                | : R1
                ;   +-----------------+-----------------+-----------------+-----------------+
                ;
                ; Output Parameters:
                ;
                ;       Character Found
                ;
                ;               R0 = Number of bytes remaining in the string (including located one)
                ;               R1 = Address of the located byte
                ;
                ;       Character NOT Found
                ;
                ;               R0 = 0
                ;               R1 = Address of one byte beyond end of string
                ;
                ; Condition Codes:
                ;
                ;       N <- 0
                ;       Z <- R0 EQL 0
                ;       V <- 0
                ;       C <- 0
                ;
                ;       The Z bit is clear if the character is located.
                ;       The Z bit is set if the character is NOT located.
                ;
                ; Side Effects:
                ;
                ;       This routine uses two longwords of stack.
                ;-
                ;
                VAX$LOCC::
5A   DD  01F7   PUSHL   R10                     ; Save R10 so it can hold handler
01F9            ESTABLISH_HANDLER       -
01F9                    STRING_ACCVIO           ; Store address of condition handler
52   DD  01FE   PUSHL   R2                      ; Save register
```

```
                     52   50    F0 8F    78   0200  1209          ASHL    #-16,R0,R2              ; Get character to be located
                          50    50 3C    0205  1210          MOVZWL  R0,R0                   ; Clear unused bits & check for 0 length
                                08 13    0208  1211          BEQL    20$                     ; Simply return if length is 0
                                         020A  1212
                                         020A  1213          MARK_POINT      LOCC_1
                          81    52 91    020A  1214 10$:     CMPB    R2,(R1)+                ; Character match?
                                0A 13    020D  1215          BEQL    30$                     ; Exit loop if yes
                             F8 50 F5    020F  1216          SOBGTR  R0,10$
                                         0212  1217
                                         0212  1218 ; If we drop through the end of the loop into the following code, then
                                         0212  1219 ; the input string was exhausted with the character NOT found.
                                         0212  1220
                          0404 8F BA     0212  1221 20$:     POPR    #^M<R2,R10>             ; Restore saved R2 and R10
                                50 D5    0216  1222          TSTL    R0                      ; Insure that C-bit is clear
                                05 05    0218  1223          RSB                             ; Return with Z-bit set
                                         0219  1224
                                         0219  1225 ; Exit path when character located
                                         0219  1226
                                51 D7    0219  1227 30$:     DECL    R1                      ; Point R1 to located character
                                F5 11    021B  1228          BRB     20$                     ; Join common code
```

```
                        .SUBTITLE       VAX$SKPC - Skip Character
                ;+
                ; Functional Description:
                ;
                ;       The character operand is compared with the bytes of the string specified
                ;       by   the  length  and  address  operands.   Comparison  continues  until
                ;       inequality is detected or all bytes of the string  have  been  compared.
                ;       If  inequality  is  detected;   the  condition  code  Z-bit  is cleared;
                ;       otherwise the Z-bit is set.
                ;
                ; Input Parameters:
                ;
                ;       R0<15:0>  = len         Length of character string
                ;       R0<23:16> = char        Character to be skipped
                ;       R1        = addr        Address of character string
                ;
                ; Intermediate State:
                ;
                ;    31                23                15                07                00
                ;   +-----------------+-----------------+-----------------+-----------------+
                ;   |    delta-PC     |      char       |                 len               | : R0
                ;   +-----------------+-----------------+-----------------+-----------------+
                ;   |                                   addr                                | : R1
                ;   +-----------------+-----------------+-----------------+-----------------+
                ;
                ; Output Parameters:
                ;
                ;       Different Character Found
                ;
                ;               R0 = Number of bytes remaining in the string (including
                ;                    unequal one)
                ;               R1 = Address of the unequal byte
                ;
                ;       All characters in string match "char"
                ;
                ;               R0 = 0
                ;               R1 = Address of one byte beyond end of string
                ;
                ; Condition Codes:
                ;
                ;       N <- 0
                ;       Z <- R0 EQL 0
                ;       V <- 0
                ;       C <- 0
                ;
                ;       The Z bit is clear if a character different from "char" is located.
                ;       The Z bit is set if the entire string is equal to "char".
                ;
                ; Side Effects:
                ;
                ;       This routine uses two longwords of stack.
                ;-
                ;
VAX$SKPC::
5A   DD         PUSHL   R10                     ; Save R10 so it can hold handler
                ESTABLISH_HANDLER       -
                        STRING_ACCVIO           ; Store address of condition handler
```

```
                52   DD  0224  1289          PUSHL   R2                              ; Save register
        52  50  F0 8F   78  0226  1290          ASHL    #-16,R0,R2                      ; Get character to be skipped
            50     50   3C  022B  1291          MOVZWL  R0,R0                           ; Clear unused bits & check for 0 length
                   08   13  022E  1292          BEQL    20$                             ; Simply return if yes
                        0230  1293
                        0230  1294          MARK_POINT      SKPC_1
            81     52   91  0230  1295 10$:     CMPB    R2,(R1)+                        ; Character match?
                   0A   12  0233  1296          BNEQ    30$                             ; Exit loop if no
                 F8 50  F5  0235  1297          SOBGTR  R0,10$
                        0238  1298
                        0238  1299 ; If we drop through the end of the loop into the following code, then
                        0238  1300 ; the input string was exhausted with all of string equal to "char".
                        0238  1301
            0404 8F     BA  0238  1302 20$:     POPR    #^M<R2,R10>                     ; Restore saved R2 and R10
                 50     D5  023C  1303          TSTL    R0                              ; Insure that C-bit is clear
                        05  023E  1304          RSB                                     ; Return with Z-bit set
                        023F  1305
                        023F  1306 ; Exit path when nonmatching character located
                        023F  1307
                51   D7  023F  1308 30$:     DECL    R1                              ; Point R1 to located character
                F5   11  0241  1309          BRB     20$                             ; Join common code
```

```
0243  1313          .SUBTITLE       VAX$MATCHC - Match Characters
0243  1314 ;+
0243  1315 ; Functional Description:
0243  1316 ;
0243  1317 ;       The source string specified by the  source  length  and  source  address
0243  1318 ;       operands  is  searched  for  a substring which matches the object string
0243  1319 ;       specified by the object length and  object  address  operands.   If  the
0243  1320 ;       substring  is  found, the condition code Z-bit is set;  otherwise, it is
0243  1321 ;       cleared.
0243  1322 ;
0243  1323 ; Input Parameters:
0243  1324 ;
0243  1325 ;       R0<15:0> = objlen       Length of object string
0243  1326 ;       R1       = objaddr      Address of object string
0243  1327 ;       R2<15:0> = srclen       Length of source string
0243  1328 ;       R3       = srcaddr      Address of source string
0243  1329 ;
0243  1330 ; Intermediate State:
0243  1331 ;
0243  1332 ;        31               23               15               07               00
0243  1333 ;       +----------------+----------------+----------------+----------------+
0243  1334 ;       |    delta-PC    |      XXXX      |                objlen          | : R0
0243  1335 ;       +----------------+----------------+----------------+----------------+
0243  1336 ;       |                                 objaddr                           | : R1
0243  1337 ;       +----------------+----------------+----------------+----------------+
0243  1338 ;       |               XXXXX             |                srclen          | : R2
0243  1339 ;       +----------------+----------------+----------------+----------------+
0243  1340 ;       |                                 srcaddr                           | : R3
0243  1341 ;       +----------------+----------------+----------------+----------------+
0243  1342 ;
0243  1343 ; Output Parameters:
0243  1344 ;
0243  1345 ;       MATCH occurred
0243  1346 ;
0243  1347 ;               R0 = 0
0243  1348 ;               R1 = Address of one byte beyond end of object string
0243  1349 ;               R2 = Number of bytes remaining in the source string
0243  1350 ;               R3 = Address of one byte beyond last byte matched
0243  1351 ;
0243  1352 ;       Strings DO NOT MATCH
0243  1353 ;
0243  1354 ;               R0 = objlen     Length of object string
0243  1355 ;               R1 = objaddr    Address of object string
0243  1356 ;               R2 = 0
0243  1357 ;               R3 = Address of one byte beyond end of source string
0243  1358 ;
0243  1359 ; Condition Codes:
0243  1360 ;
0243  1361 ;       N <- 0
0243  1362 ;       Z <- R0 EQL 0
0243  1363 ;       V <- 0
0243  1364 ;       C <- 0
0243  1365 ;
0243  1366 ;       The Z bit is clear if the object does not match the source
0243  1367 ;       The Z bit is set if a MATCH occurred
0243  1368 ;
0243  1369 ; Side Effects:
```

```
                     0243  1370 ;
                     0243  1371 ;       This routine uses five longwords of stack for saved registers.
                     0243  1372 ;-
                     0243  1373
                     0243  1374         .ENABLE LOCAL_BLOCK
                     0243  1375
                     0243  1376 VAX$MATCHC::
50   50   3C         0243  1377         MOVZWL  R0,R0                   ; Clear unused bits & check for 0 length
     3D   13         0246  1378         BEQL    40$                     ; Simply return if length is 0
52   52   3C         0248  1379         MOVZWL  R2,R2                   ; Clear unused bits & check for 0 length
     35   13         024B  1380         BEQL    30$                     ; Return with condition codes set
                     024D  1381                                         ;  based on R0 GTRU 0
          5A   DD    024D  1382         PUSHL   R10                     ; Save R10 so it can hold handler
                     024F  1383         ESTABLISH_HANDLER       -
                     024F  1384                 STRING_ACCVIO           ; Store address of condition handler
                     0254  1385
                     0254  1386 ; The next set of instructions saves R4..R7 and copy R0..R3 to R4..R7
                     0254  1387
          57   DD    0254  1388         PUSHL   R7                      ;
          56   DD    0256  1389         PUSHL   R6                      ;
          55   DD    0258  1390         PUSHL   R5                      ;
          54   DD    025A  1391         PUSHL   R4                      ;
54   50   7D         025C  1392         MOVQ    R0,R4                   ;
56   52   7D         025F  1393         MOVQ    R2,R6                   ;
                     0262  1394
          0A   11    0262  1395         BRB     TOP_OF_LOOP             ; Skip reset code on first pass
                     0264  1396
                     0264  1397 ; The following code resets the object string parameters (R0,R1) and
                     0264  1398 ; points the source string parameters (R2,R3) to the next byte. (Note
                     0264  1399 ; that there is no explicit test for R6 going to zero. That test is
                     0264  1400 ; implicit in the CMPL R0,R2 at TOP_OF_LOOP.)
                     0264  1401
                     0264  1402 ; In fact, this piece of code is really two nested loops. The object string
                     0264  1403 ; is traversed for each substring in the source string. If no match occurs,
                     0264  1404 ; then the source string is advanced by one character and the inner loop is
                     0264  1405 ; traversed again.
                     0264  1406
                     0264  1407 RESET_STRINGS:
          56   D7    0264  1408         DECL    R6                      ; One less byte in source string
          57   D6    0266  1409         INCL    R7                      ; ... at address one byte larger
50   54   7D         0268  1410         MOVQ    R4,R0                   ; Reset object string descriptor
52   56   7D         026B  1411         MOVQ    R6,R2                   ; Load new source string descriptor
                     026E  1412
                     026E  1413 TOP_OF_LOOP:
52   50   D1         026E  1414         CMPL    R0,R2                   ; Compare sizes of source and object
     17   1A         0271  1415         BGTRU   50$                     ; Object larger than source => NO MATCH
                     0273  1416         MARK_POINT      MATCHC_1
83   81   91         0273  1417 10$:     CMPB    (R1)+,(R3)+             ; Does next character match?
     EC   12         0276  1418         BNEQ    RESET_STRINGS           ; Exit inner loop if no match
   F8 50   F5        0278  1419         SOBGTR  R0,10$                  ; Object exhausted?
                     027B  1420
                     027B  1421 ; If we drop through the loop, then a MATCH occurred. Set the correct
                     027B  1422 ; output parameters and exit. Note that R0 is equal to zero, which
                     027B  1423 ; will cause the condition codes (namely the Z-bit) to indicate a MATCH.
                     027B  1424
52   54   C2         027B  1425         SUBL    R4,R2                   ; Subtract objlen from srclen
                     027E  1426
```

```
                04F0 8F     BA   027E  1427 20$:    POPR    #^M<R4,R5,R6,R7,R10>    ; Restore scratch registers and R10
                                 0282  1428
                     50     D5   0282  1429 30$:    TSTL    R0                      ; Set condition codes
                            05   0284  1430         RSB                             ; Return
                                 0285  1431
                                 0285  1432 ; This code executes if the object string is zero length.  The upper
                                 0285  1433 ; 16 bits have to be cleared in R2 and then the condition codes are set
                                 0285  1434 ; to indicate that a MATCH occurred.
                                 0285  1435
                     52     52   3C   0285  1436 40$:    MOVZWL  R2,R2                   ; Clear unused bits
                            F8   11   0288  1437         BRB     30$                     ; Join common code
                                 028A  1438
                                 028A  1439 ; This code executes if the strings DO NOT MATCH. The actual code state
                                 028A  1440 ; that brings us here is that the object string is now larger than the
                                 028A  1441 ; remaining piece of the source string, making a match impossible.
                                 028A  1442
                     52     D4   028A  1443 50$:    CLRL    R2                      ; R2 contains zero in no match case
                53   57     56   C1   028C  1444         ADDL3   R6,R7,R3                ; Point R3 to end of source string
                            EC   11   0290  1445         BRB     20$                     ; Join common exit code
                                 0292  1446
                                 0292  1447         .DISABLE        LOCAL_BLOCK
```

```
                        .SUBTITLE       VAX$CRC - Calculate Cyclic Redundancy Check
                ;+
                ; Functional Description:
                ;
                ;       The CRC of the data stream described by the string descriptor is
                ;       calculated.   The initial CRC is given by inicrc and is normally 0 or -1
                ;       unless the CRC is calculated in several steps.  The result is left in
                ;       R0.   If the polynomial is less than order-32, the result must be
                ;       extracted from the result.  The CRC polynomial is expressed by the
                ;       contents of the 16-longword table.
                ;
                ; Input Parameters:
                ;
                ;       R0        = inicrc      Initial CRC
                ;       R1        = tbl         Address of 16-longword table
                ;       R2<15:0>  = strlen      Length of data stream
                ;       R3        = stream      Address of data stream
                ;
                ; Intermediate State:
                ;
                ;    31               23               15               07               00
                ;   +----------------+----------------+----------------+----------------+
                ;   |                                inicrc                               | : R0
                ;   +----------------+----------------+----------------+----------------+
                ;   |                                  tbl                                | : R1
                ;   +----------------+----------------+----------------+----------------+
                ;   |    delta-PC    |      XXXX      |                strlen              | : R2
                ;   +----------------+----------------+----------------+----------------+
                ;   |                                stream                               | : R3
                ;   +----------------+----------------+----------------+----------------+
                ;
                ; Output Parameters:
                ;
                ;       R0 = Final CRC value
                ;       R1 = 0
                ;       R2 = 0
                ;       R3 = Address of one byte beyond end of data stream
                ;
                ; Condition Codes:
                ;
                ;       N <- R0 LSS 0
                ;       Z <- R0 EQL 0
                ;       V <- 0
                ;       C <- 0
                ;
                ;       The condition codes simply reflect the final CRC value.
                ;
                ; Side Effects:
                ;
                ;       This routine uses three longwords of stack.
                ;
                ; Notes:
                ;
                ;       Note that the main loop of this routine is slightly complicated
                ;       by the need to allow the routine to be interrupted and restarted
                ;       from its entry point. This requirement prevents R0 from being
                ;       partially updates several times during each trip through the loop.
```

```
                                0292  1508 ;       Instead, R5 is used to record the partial modifications and R5 is
                                0292  1509 ;       copied into R0 at the last step (with the extra MOVL R5,R0).
                                0292  1510 ;-
                                0292  1511
                                0292  1512 VAX$CRC::
                  52    52  3C  0292  1513          MOVZWL  R2,R2                   ; Clear unused bits & check for 0 length
                        39  13  0295  1514          BEQL    20$                     ; All done if zero
                        5A  DD  0297  1515          PUSHL   R10                     ; Save R10 so it can hold handler
                                0299  1516          ESTABLISH_HANDLER       -
                                0299  1517                  STRING_ACCVIO           ; Store address of condition handler
                        55  DD  029E  1518          PUSHL   R5                      ; Save contents of scratch register
                  55    50  D0  02A0  1519          MOVL    R0,R5                   ; Copy inicrc to R5
                        54  DD  02A3  1520          PUSHL   R4                      ; Save contents of scratch register
                        54  D4  02A5  1521          CLRL    R4                      ; Clear it out (we only use R4<7:0>)
                                02A7  1522
                                02A7  1523 ; This is the main loop that operates on each byte in the input stream
                                02A7  1524
                                02A7  1525          MARK_POINT      CRC_1
                  55    83  8C  02A7  1526 10$:     XORB2   (R3)+,R5                ; Include next byte
                                02AA  1527
                                02AA  1528 ; The next three instructions are really the body of a loop that executes
                                02AA  1529 ; twice on each pass through the outer loop. Rather than incur additional
                                02AA  1530 ; overhead, this inner loop is expanded in line.
                                02AA  1531
               54   55   F0 8F  8B  02AA  1532          BICB3   #^XF0,R5,R4             ; Get right 4 bits
          55   55   1C   04     EF  02AF  1533          EXTZV   #4,#28,R5,R5            ; Shift result right 4
                                02B4  1534          MARK_POINT      CRC_2
                    55   6144   CC  02B4  1535          XORL2   (R1)[R4],R5             ; Include table entry
                                02B8  1536
               54   55   F0 8F  8B  02B8  1537          BICB3   #^XF0,R5,R4             ; Get right 4 bits
          55   55   1C   04     EF  02BD  1538          EXTZV   #4,#28,R5,R5            ; Shift result right 4
                                02C2  1539          MARK_POINT      CRC_3
                    55   6144   CC  02C2  1540          XORL2   (R1)[R4],R5             ; Include table entry
                                02C6  1541
                      50   55   D0  02C6  1542          MOVL    R5,R0                   ; Preserve latest complete result
                                02C9  1543
                        DB 52    F5  02C9  1544          SOBGTR  R2,10$                  ; Count down loop
                                02CC  1545
                      0430 8F    BA  02CC  1546          POPR    #^M<R4,R5,R10>          ; Restore saved R4, R5, and R10
                                02D0  1547
                           51   D4  02D0  1548 20$:     CLRL    R1                      ; R1 must be zero on exit
                           50   D5  02D2  1549          TSTL    R0                      ; Determine N- and Z-bits
                                02D4  1550                                          ; (Note that TSTL clears V- and C-bits)
                                05  02D4  1551          RSB                             ; Return to caller
```

```
                                .SUBTITLE       STRING_ACCVIO - Exception Dispatcher
                        ;+
                        ; Functional Description:
                        ;
                        ;       This routine receives control when an access violation occurs while
                        ;       executing within the emulator. This routine determines whether the
                        ;       exception occurred while accessing a source or destination string.
                        ;       (This check is made based on the PC of the exception.)
                        ;
                        ;       If the PC is one that is recognized by this routine, then the state of
                        ;       the instruction (character counts, string addresses, and the like) are
                        ;       restored to a state where the instruction/routine can be restarted
                        ;       after the cause for the exception is eliminated. Control is then
                        ;       passed to a common routine that sets up the stack and the exception
                        ;       parameters in such a way that the instruction or routine can restart
                        ;       transparently.
                        ;
                        ;       If the exception occurs at some unrecognized PC, then the exception is
                        ;       reflected to the user as an exception that occurred within the
                        ;       emulator.
                        ;
                        ;       There are two exceptions that can occur that are not backed up to a
                        ;       consistent state.
                        ;
                        ;           1.  If stack overflow occurs due to use of the stack by one of
                        ;               the VAX$xxxxxx routines, it is unlikely that this routine
                        ;               will even execute because the code that transfers control
                        ;               here must first copy the parameters to the exception stack
                        ;               and that operation would fail. (The failure causes control
                        ;               to be transferred to VMS, where the stack expansion logic is
                        ;               invoked and the routine resumed transparently.)
                        ;
                        ;           2.  If assumptions about the address space change out from under
                        ;               these routines (because an AST deleted a portion of the
                        ;               address space or a similar silly thing), the handling of the
                        ;               exception is UNPREDICTABLE.
                        ;
                        ; Input Parameters:
                        ;
                        ;       R0  - Value of SP when the exception occurred
                        ;       R1  - PC of exception
                        ;       R2  - Scratch
                        ;       R3  - Scratch
                        ;       R10 - Address of this routine (but that was already used so R10
                        ;             can be used for a scratch register if needed)
                        ;
                        ;       00(SP) - Saved R0 (Contents of R0 when exception occurred)
                        ;       04(SP) - Saved R1 (Contents of R1 when exception occurred)
                        ;       08(SP) - Saved R2 (Contents of R2 when exception occurred)
                        ;       12(SP) - Saved R3 (Contents of R3 when exception occurred)
                        ;
                        ;       16(SP) - Return PC in exception dispatcher in operating system
                        ;
                        ;       20(SP) - First longword of system-specific exception data
                        ;       xx(SP) - First longword of system-specific exception data
                        ;
                        ;       The address of the next longword is the position of the stack when
```

```
02D5  1612 ;       the exception occurred. This address is contained in R0 on entry
02D5  1613 ;       to this routine.
02D5  1614 ;
02D5  1615 ; R0 -> <4*<N+1> + 16>(SP) - Instruction-specific data
02D5  1616 ;          .                - Optional instruction-specific data
02D5  1617 ;          .                - Saved R10
02D5  1618 ;       <4*<N+M> + 16>(SP) - Return PC from VAX$xxxxxx routine (M is the number
02D5  1619 ;                            of instruction-specific longwords, including the
02D5  1620 ;                            saved R10. M is guaranteed greater than zero.)
02D5  1621 ;
02D5  1622 ; Implicit Input:
02D5  1623 ;
02D5  1624 ;       It is assumed that the contents of all registers (except R0 to R3)
02D5  1625 ;       coming into this routine are unchanged from their contents when the
02D5  1626 ;       exception occurred. (For R0 through R3, this assumption applies to the
02D5  1627 ;       saved register contents on the top of the stack. Any modification to
02D5  1628 ;       these registers must be made to their saved copies and not to the
02D5  1629 ;       registers themselves.)
02D5  1630 ;
02D5  1631 ;       It is further assumed that the exception PC is within the bounds of
02D5  1632 ;       this module. (Violation of this assumption is simply an inefficiency.)
02D5  1633 ;
02D5  1634 ;       Finally, the macro BEGIN_MARK_POINT should have been invoked at the
02D5  1635 ;       beginning of this module to define the symbols
02D5  1636 ;
02D5  1637 ;               MODULE_BASE
02D5  1638 ;               PC_TABLE_BASE
02D5  1639 ;               HANDLER_TABLE_BASE
02D5  1640 ;               TABLE_SIZE
02D5  1641 ;
02D5  1642 ; Output Parameters:
02D5  1643 ;
02D5  1644 ;       If the exception is recognized (that is, if the exception PC is
02D5  1645 ;       associated with one of the mark points), control is passed to the
02D5  1646 ;       context-specific routine that restores the instruction state to a
02D5  1647 ;       uniform point from which it can be restarted.
02D5  1648 ;
02D5  1649 ;               R0  - Value of SP when exception occurred
02D5  1650 ;               R1  - scratch
02D5  1651 ;               R2  - scratch
02D5  1652 ;               R3  - scratch
02D5  1653 ;               R10 - scratch
02D5  1654 ;
02D5  1655 ;        R0 ->  zz(SP) - Instruction-specific data begins here
02D5  1656 ;
02D5  1657 ;       The instruction-specific routines eventually pass control back to the
02D5  1658 ;       host system with the following register contents.
02D5  1659 ;
02D5  1660 ;               R0  - Address of return PC from VAX$xxxxxx routine
02D5  1661 ;               R1  - Byte offset from top of stack (into saved R0 through R3)
02D5  1662 ;                     to indicate where to store the delta-PC (if so required)
02D5  1663 ;               R10 - Restored to its value on entry to VAX$xxxxxx
02D5  1664 ;
02D5  1665 ;       If the exception PC occurred somewhere else (such as a stack access),
02D5  1666 ;       the saved registers are restored and control is passed back to the
02D5  1667 ;       host system with an RSB instruction.
02D5  1668 ;
```

```
                                02D5  1669 ; Implicit Output:
                                02D5  1670 ;
                                02D5  1671 ;       The register contents are modified to put the intermediate state of
                                02D5  1672 ;       the instruction into a consistent state from which it can be
                                02D5  1673 ;       continued. Any changes to R0 through R3 are made in their saved state
                                02D5  1674 ;       on the top of the stack. Any scratch registers saved by each
                                02D5  1675 ;       VAX$xxxxxx routine are restored.
                                02D5  1676 ;-
                                02D5  1677
                                02D5  1678 STRING_ACCVIO:
                          52    D4  02D5  1679          CLRL    R2                      ; Initialize the counter
                      FD25 CF   9F  02D7  1680          PUSHAB  MODULE_BASE             ; Store base address of this module
                          51    C2  02DB  1681          SUBL2   (SP)+,R1                ; Get PC relative to this base
                                02DE  1682
                0000'CF42     51    B1  02DE  1683 10$:      CMPW    R1,PC_TABLE_BASE[R2]    ; Is this the right PC?
                              07    13  02E4  1684          BEQL    20$                     ; Exit loop if true
                          F4  52    17  02E6  1685          AOBLSS  #TABLE_SIZE,R2,10$      ; Do the entire table
                                02EA  1686
                                02EA  1687 ; If we drop through the dispatching based on PC, then the exception is not
                                02EA  1688 ; one that we want to back up. We simply reflect the exception to the user.
                                02EA  1689
                              0F    BA  02EA  1690          POPR    #^M<R0,R1,R2,R3>        ; Restore saved registers
                              05    05  02EC  1691          RSB                             ; Let VMS reflect the exception
                                02ED  1692
                                02ED  1693 ; The exception PC matched one of the entries in our PC table. R2 contains
                                02ED  1694 ; the index into both the PC table and the handler table. R1 has served
                                02ED  1695 ; its purpose and can be used as a scratch register.
                                02ED  1696
51              0000'CF42       3C  02ED  1697 20$:      MOVZWL  HANDLER_TABLE_BASE[R2],R1       ; Get the offset to the handler
                FD08 CF41       17  02F3  1698          JMP     MODULE_BASE[R1]         ; Pass control to the handler
```

```
02F8  1700          .SUBTITLE       Packing Routines for String Instructions
02F8  1701 ;+
02F8  1702 ; Functional Description:
02F8  1703 ;
02F8  1704 ;       These routines are used to store the intermediate state of the state
02F8  1705 ;       of the string instructions (except MOVTC and MOVTUC) into the registers
02F8  1706 ;       that are altered by a given instruction.
02F8  1707 ;
02F8  1708 ; Input Parameters:
02F8  1709 ;
02F8  1710 ;       R0 - Points to top of stack when exception occurred
02F8  1711 ;
02F8  1712 ;       See each routine- and context-specific entry point for more details.
02F8  1713 ;
02F8  1714 ;       In general, register contents for counters and string pointers that
02F8  1715 ;       are naturally tracking through a string are not listed. Register
02F8  1716 ;       contents that are out of the ordinary (different from those listed
02F8  1717 ;       in the intermediate state pictures in each routine header) are listed.
02F8  1718 ;
02F8  1719 ; Output Parameters:
02F8  1720 ;
02F8  1721 ;       R0 - Points to return PC from VAX$xxxxxx
02F8  1722 ;       R1 - Locates specific byte in R0..R3 that will contain the delta-PC
02F8  1723 ;
02F8  1724 ;       All scratch registers (including R10) that are not supposed to be
02F8  1725 ;       altered by the routine are restored to their contents when the
02F8  1726 ;       routine was originally entered.
02F8  1727 ;
02F8  1728 ; Notes:
02F8  1729 ;
02F8  1730 ;       In all of the instruction-specific routines, the state of the stack
02F8  1731 ;       will be shown as it was when the exception occurred. All offsets will
02F8  1732 ;       be pictured relative to R0. In addition, relevant contents of R0
02F8  1733 ;       through R3 will be listed as located in the registers themselves, even
02F8  1734 ;       though the actual code will manipulate the saved values of these
02F8  1735 ;       registers located on the top of the stack.
02F8  1736 ;
02F8  1737 ;       The apparent arbitrary order of the instruction-specific routines is
02F8  1738 ;       dictated by the amount of code that they can share. The most sharing
02F8  1739 ;       occurs at the middle of the code, for instructions like CMPC5 and
02F8  1740 ;       SCANC. The CRC routines, because they are the only routines that store
02F8  1741 ;       the delta-PC in R2 appear first. The CMPC3 instruction has no
02F8  1742 ;       instruction-specific code that cannot be shared with all of the other
02F8  1743 ;       routines so it appears at the end.
02F8  1744 ;-
02F8  1745
02F8  1746          .ENABLE         LOCAL_BLOCK
02F8  1747
02F8  1748 ;+
02F8  1749 ; CRC Packing Routine
02F8  1750 ;
02F8  1751 ;       R4 - Scratch
02F8  1752 ;       R5 - Scratch
02F8  1753 ;
02F8  1754 ;       00(R0) - Saved R4
02F8  1755 ;       04(R0) - Saved R5
02F8  1756 ;       08(R0) - Saved R10
```

```
                     02F8  1757 ;       12(R0) - Return PC
                     02F8  1758 ;
                     02F8  1759 ; If entry is at CRC_2 or CRC_3, the exception occurred after the string
                     02F8  1760 ; pointer, R3, was advanced. That pointer must be backed up to achieve a
                     02F8  1761 ; consistent state.
                     02F8  1762 ;-
                     02F8  1763
                     02F8  1764 CRC_2:
                     02F8  1765 CRC_3:
      OC AE    D7    02F8  1766         DECL    PACK_L_SAVED_R3(SP)     ; Back up string pointer
                     02FB  1767 CRC_1:
54    80    7D       02FB  1768         MOVQ    (R0)+,R4                ; Restore R4 and R5
51    0B    9A       02FE  1769         MOVZBL  #CRC_B_DELTA_PC,R1      ; Indicate offset used to store delta-PC
      29    11       0301  1770         BRB     30$                     ; Not much common code left but use it
                     0303  1771
                     0303  1772 ;+
                     0303  1773 ; MATCHC Packing Routine
                     0303  1774 ;
                     0303  1775 ;       R4<15:0> - Number of characters in object string
                     0303  1776 ;       R5       - Address of object string
                     0303  1777 ;       R6<15:0> - Number of characters remaining in source string
                     0303  1778 ;       R7       - Updated pointer into source string
                     0303  1779 ;
                     0303  1780 ;       00(R0) - Saved R4
                     0303  1781 ;       04(R0) - Saved R5
                     0303  1782 ;       08(R0) - Saved R6
                     0303  1783 ;       12(R0) - Saved R7
                     0303  1784 ;       16(R0) - Saved R10
                     0303  1785 ;       20(R0) - Return PC
                     0303  1786 ;
                     0303  1787 ; Note that the MATCHC instruction is backed up to the top of its inner loop.
                     0303  1788 ; That is, when the instruction restarts, it will begin looking for a match
                     0303  1789 ; between the first character of the object string and the latest starting
                     0303  1790 ; character in the source string.
                     0303  1791 ;-
                     0303  1792
                     0303  1793 MATCHC_1:
   6E    54    7D      0303  1794         MOVQ    R4,PACK_L_SAVED_R0(SP)  ; Reset object string to its beginning
08 AE    56    7D      0306  1795         MOVQ    R6,PACK_L_SAVED_R2(SP)  ; Reset to updated start of source string
   54    80    7D      030A  1796         MOVQ    (R0)+,R4                ; Restore R4 and R5
   56    80    7D      030D  1797         MOVQ    (R0)+,R6                ; ... and R6 and R7
         17    11      0310  1798         BRB     20$                     ; Exit through common code path
                     0312  1799
                     0312  1800 ;+
                     0312  1801 ; CMPC5 Packing Routine
                     0312  1802 ;
                     0312  1803 ;       R4<7:0> - Fill character operand
                     0312  1804 ;
                     0312  1805 ;       00(R0) - Saved R4
                     0312  1806 ;       04(R0) - Saved R10
                     0312  1807 ;       08(R0) - Return PC
                     0312  1808 ;-
                     0312  1809
                     0312  1810 CMPC5_1:
                     0312  1811 CMPC5_2:
                     0312  1812 CMPC5_3:
02 AE    54    90      0312  1813         MOVB    R4,CMPC5_B_FILL(SP)     ; Pack "fill" into R0<23:16>
```

```
                     03   11   0316  1814          BRB     10$                     ; Merge with code to restore R4
                                0318  1815
                                0318  1816 ;+
                                0318  1817 ; SCANC and SPANC  Packing Routine
                                0318  1818 ;
                                0318  1819 ;       R4 - Scratch
                                0318  1820 ;
                                0318  1821 ;       00(R0) - Saved R4
                                0318  1822 ;       04(R0) - Saved R10
                                0318  1823 ;       08(R0) - Return PC
                                0318  1824 ;
                                0318  1825 ; If entry is at SCANC_2 or SPANC_2, the exception occurred after the string
                                0318  1826 ; pointer, R1, was advanced. That pointer must be backed up to achieve a
                                0318  1827 ; consistent state.
                                0318  1828 ;-
                                0318  1829
                                0318  1830 SCANC_2:
                                0318  1831 SPANC_2:
                   04 AE    D7  0318  1832          DECL    PACK_L_SAVED_R1(SP)     ; Back up string pointer
                                031B  1833 SCANC_1:
                                031B  1834 SPANC_1:
                54   80    D0  031B  1835 10$:     MOVL    (R0)+,R4                ; Restore R4
                     09    11  031E  1836          BRB     20$                     ; Exit through common code path
                                0320  1837
                                0320  1838 ;+
                                0320  1839 ; LOCC and SKPC Packing Routine
                                0320  1840 ;
                                0320  1841 ;       R2<7:0> - Character operand
                                0320  1842 ;
                                0320  1843 ;       00(R0) - Saved R2
                                0320  1844 ;       04(R0) - Saved R10
                                0320  1845 ;       08(R0) - Return PC
                                0320  1846 ;-
                                0320  1847
                                0320  1848 LOCC_1:
                                0320  1849 SKPC_1:
                                0320  1850
                                0320  1851          ASSUME LOCC_B_CHAR EQ SKPC_B_CHAR
                                0320  1852
          02 AE    08 AE    90  0320  1853          MOVB    PACK_L_SAVED_R2(SP),LOCC_B_CHAR(SP) ; Pack "char" into R0<23:16>
             08 AE    80    D0  0325  1854          MOVL    (R0)+,PACK_L_SAVED_R2(SP) ; Restore saved R2
                                0329  1855
                                0329  1856 ;+
                                0329  1857 ; CMPC3 Packing Routine
                                0329  1858 ;
                                0329  1859 ;       00(R0) - Saved R10
                                0329  1860 ;       04(R0) - Return PC
                                0329  1861 ;-
                                0329  1862
                                0329  1863          ASSUME CMPC5_B_DELTA_PC EQ CMPC3_B_DELTA_PC
                                0329  1864          ASSUME SCANC_B_DELTA_PC EQ CMPC3_B_DELTA_PC
                                0329  1865          ASSUME SPANC_B_DELTA_PC EQ CMPC3_B_DELTA_PC
                                0329  1866          ASSUME LOCC_B_DELTA_PC EQ CMPC3_B_DELTA_PC
                                0329  1867          ASSUME SKPC_B_DELTA_PC EQ CMPC3_B_DELTA_PC
                                0329  1868          ASSUME MATCHC_B_DELTA_PC EQ CMPC3_B_DELTA_PC
                                0329  1869
                                0329  1870 CMPC3_1:
```

```
                51   03   9A  0329  1871 20$:    MOVZBL  #CMPC3_B_DELTA_PC,R1    ; Indicate that R0 gets delta PC
                5A   80   D0  032C  1872 30$:    MOVL    (R0)+,R10               ; Restore saved R10
                                  032F  1873
                                  032F  1874        ASSUME PACK_V_FPD LE 15       ; Insure that both of these bits
                                  032F  1875        ASSUME PACK_V_FPD LE 15       ;  can be contained in a word
                                  032F  1876
              51   0300 8F   A8  032F  1877        BISW    #<PACK_M_FPD!-        ; Indicate that FPD gets set
                                  0334  1878                PACK_M_ACCVIO>,R1     ; Exception is an access violation
                     FCC9'  31  0334  1879        BRW     VAX$REFLECT_FAULT     ; Modify stack and reflect exception
                                  0337  1880
                                  0337  1881        .DISABLE        LOCAL_BLOCK
```

```
                        .SUBTITLE       Packing Routines for MOVTC and MOVTUC
                ;+
                ; Functional Description:
                ;
                ;       These routines are used to store the intermediate state of the state
                ;       of the MOVTC and MOVTUC instructions into the registers R0 through R5.
                ;       The main reason for keeping these two routines separate from the rest
                ;       of the string instructions is that R10 is not stored directly adjacent
                ;       to the return PC. This means that there is no code that can be shared
                ;       with the rest of the instructions.
                ;
                ; Input Parameters:
                ;
                ;       R0 - Points to top of stack when exception occurred
                ;
                ;       See the context-specific entry point for more details.
                ;
                ; Output Parameters:
                ;
                ;       R0 - Points to return PC from VAX$xxxxxx
                ;       R1 - Locates specific byte in R0..R3 that will contain the delta-PC
                ;
                ;       All scratch registers (including R10) that are not supposed to be
                ;       altered by the routine are restored to their contents when the
                ;       routine was originally entered.
                ;
                ; Notes:
                ;
                ;       See the notes in the routine header for the storage routines for
                ;       the rest of the string instructions.
                ;-
```

```
0337  1915 ;+
0337  1916 ; MOVTC Packing Routine (if moving in the FORWARD direction)
0337  1917 ;
0337  1918 ; The entry points MOVTC_1, MOVTC_2, and MOVTC_3 are used when moving the
0337  1919 ; string in the forward direction. If the entry is at MOVTC_2, then the
0337  1920 ; source and destination strings are out of synch and R1 must be adjusted
0337  1921 ; (decremented) to keep the two strings in step.
0337  1922 ;
0337  1923 ; In the MOVE_FORWARD routine, there is a need for a scratch register before
0337  1924 ; the fill character is used. R2 is used as this scratch and its original
0337  1925 ; contents, the fill character, are saved on the stack. The entry points
0337  1926 ; MOVTC_1 and MOVTC_2 have the stack in this state.
0337  1927 ;
0337  1928 ;       R2 - Scratch
0337  1929 ;
0337  1930 ;       00(R0) - Saved R2
0337  1931 ;       04(R0) - Saved R10
0337  1932 ;       08(R0) - Saved R0
0337  1933 ;                <31:16> - Initial contents of R0
0337  1934 ;                <15:00> - Contents of R0 at time of latest entry to VAX$MOVTC
0337  1935 ;       12(R0) - Saved R4
0337  1936 ;                <31:16> - Initial contents of R4
0337  1937 ;                <15:00> - Contents of R4 at time of latest entry to VAX$MOVTC
0337  1938 ;       16(R0) - Return PC
0337  1939 ;
0337  1940 ; If entry is at MOVTC_3, then there are no registers other than R0 and R4
0337  1941 ; (and of course R10) that are saved on the stack.
0337  1942 ;
0337  1943 ;       00(R0) - Saved R10
0337  1944 ;       04(R0) - Saved R0
0337  1945 ;                <31:16> - Initial contents of R0
0337  1946 ;                <15:00> - Contents of R0 at time of latest entry to VAX$MOVTC
0337  1947 ;       08(R0) - Saved R4
0337  1948 ;                <31:16> - Initial contents of R4
0337  1949 ;                <15:00> - Contents of R4 at time of latest entry to VAX$MOVTC
0337  1950 ;       12(R0) - Return PC
0337  1951 ;
0337  1952 ; The following are register contents at the time that the exception occurred.
0337  1953 ;
0337  1954 ;       R0 - Number of bytes remaining to be modified in source string
0337  1955 ;       R1 - Address of current byte in source string (except at MOVTC_2)
0337  1956 ;       R2 - Junk or fill character (if entry at MOVTC_3)
0337  1957 ;       R3 - Address of translation table (unchanged during execution)
0337  1958 ;       R4 - Signed difference between current lengths of source and destination
0337  1959 ;       R5 - Address of current byte in destination string
0337  1960 ;
0337  1961 ;       R10 - Access violation handler address (so can be used as scratch)
0337  1962 ;
0337  1963 ; Note that if R4 LSSU 0, then the value of R0 represents the number of bytes
0337  1964 ; in the source string remaining to be modified. There are also excess bytes
0337  1965 ; of the source string that will be untouched by the complete execution of
0337  1966 ; this instruction. (In fact, at completion, R0 will contain the number of
0337  1967 ; unmodified bytes.)
0337  1968 ;
0337  1969 ; Note further that entry at MOVTC_3 is impossible with R4 LSSU 0 because
0337  1970 ; MOVTC_3 indicates that an access violation occurred while storing the
0337  1971 ; fill character in the destination and that can only happen when the output
```

```
                     0337  1972 ; string is longer than the input string.
                     0337  1973 ;
                     0337  1974 ; The state that must be modified before being stored depends on the sign of
                     0337  1975 ; R4, which in turn depends on which of source and destination is longer.
                     0337  1976 ;
                     0337  1977 ;       R4 GEQU 0 => srclen LEQU dstlen
                     0337  1978 ;
                     0337  1979 ;               R0 - unchanged
                     0337  1980 ;               R4 - increased by R0 (R4 <- R4 + R0)
                     0337  1981 ;
                     0337  1982 ;       R4 LSSU 0 => srclen GTRU dstlen
                     0337  1983 ;
                     0337  1984 ;               R0 - increased by negative of R4 (R0 <- R0 + ABS(R4))
                     0337  1985 ;               R4 - replaced with input value of R0 (R4 <- R0)
                     0337  1986 ;-
                     0337  1987
                     0337  1988         .ENABLE         LOCAL_BLOCK
                     0337  1989
                     0337  1990 MOVTC_2:
          04 AE   D7 0337  1991         DECL    PACK_L_SAVED_R1(SP)     ; Back up source string
                     033A  1992
                     033A  1993 MOVTC_1:
    08 AE   80   D0 033A  1994         MOVL    (R0)+,PACK_L_SAVED_R2(SP) ; Restore contents of saved R2
            54   D5 033E  1995         TSTL    R4                      ; R4 LSSU 0 => srclen GTRU dstlen
            0B   18 0340  1996         BGEQ    5$                      ; Branch if srclen LEQU dstlen
       5A   54   CE 0342  1997         MNEGL   R4,R10                  ; Save absloute value of difference
       54   6E   D0 0345  1998         MOVL    PACK_L_SAVED_R0(SP),R4  ; Get updated dstlen     (R4 <- R0)
       6E   5A   C0 0348  1999         ADDL    R10,PACK_L_SAVED_R0(SP) ; ... and updated srclen (R0 <- R0 - R4)
            03   11 034B  2000         BRB     10$
                     034D  2001
       54   6E   C0 034D  2002 5$:     ADDL    PACK_L_SAVED_R0(SP),R4  ; Reset correct count of destination
                     0350  2003
                     0350  2004 MOVTC_3:
       5A   80   D0 0350  2005 10$:    MOVL    (R0)+,R10               ; Restore saved R10
                     0353  2006
                     0353  2007         ASSUME MOVTUC_W_INISRCLEN EQ MOVTC_W_INISRCLEN
                     0353  2008
 02 AE   02 A0   B0 0353  2009         MOVW    2(R0),MOVTC_W_INISRCLEN(SP) ; Save high-order word of R0
       50   04   C0 0358  2010         ADDL    #4,R0                   ; Point R0 to saved R4
       60   54   B0 035B  2011         MOVW    R4,(R0)                 ; Store low order R4 in saved R4
       54   80   D0 035E  2012         MOVL    (R0)+,R4                ; Restore all of R4
                     0361  2013
                     0361  2014         ASSUME MOVTUC_B_DELTA_PC EQ MOVTC_B_DELTA_PC
                     0361  2015
                     0361  2016 ; Indicate that R2<31:24> gets delta-PC and cause the FPD bit to be set
                     0361  2017
51   0000030B 8F   D0 0361  2018         MOVL    #<MOVTC_B_DELTA_PC!-    ; Locate delta-PC offset
                     0368  2019                 PACK_M_FPD!-            ; Set FPD bit in exception PSL
                     0368  2020                 PACK_M_ACCVIO>,R1       ; Indicate an access violation
                     0368  2021
                     0368  2022         ASSUME MOVTUC_M_FPD EQ MOVTC_M_FPD
                     0368  2023         ASSUME MOVTUC_B_FLAGS EQ MOVTC_B_FLAGS
                     0368  2024
 09 AE   01   88 0368  2025         BISB    #MOVTC_M_FPD,MOVTC_B_FLAGS(SP)  ; Set internal FPD bit
       FC91'  31 036C  2026         BRW     VAX$REFLECT_FAULT       ; Reflect exception to user
```

```
                     ;+
                     ; MOVTC Packing Routine (if moving in the BACKWARD direction)
                     ;
                     ; The entry points MOVTC_4, MOVTC_5, and MOVTC_6 are used when moving the
                     ; string in the backward direction. If the entry is at MOVTC_6, then the
                     ; source and destination strings are out of synch and R1 must be adjusted
                     ; (incremented) to keep the two strings in step.
                     ;
                     ; At entry points MOVTC_5 and MOVTC_6, we must reset the source string
                     ; pointer, R1, to the beginning of the string because it is currently set up
                     ; to traverse the string from its high-address end. The details of this reset
                     ; operation depend on the relative lengths of the source and destination
                     ; strings as described below.
                     ;
                     ; At all three entry points, we must reset the destination string
                     ; pointer, R5, to the beginning of the string because it is currently
                     ; set up to traverse the string from its high-address end.
                     ;
                     ;       00(R0) - Saved R10
                     ;       04(R0) - Saved R0
                     ;                <31:16> - Initial contents of R0
                     ;                <15:00> - Contents of R0 at time of latest entry to VAX$MOVTC
                     ;       08(R0) - Saved R4
                     ;                <31:16> - Initial contents of R4
                     ;                <15:00> - Contents of R4 at time of latest entry to VAX$MOVTC
                     ;       12(R0) - Return PC
                     ;
                     ; The following are register contents at the time that the exception occurred.
                     ;
                     ;       R0 - Number of bytes remaining to be modified in source string
                     ;       R1 - Address of current byte in source string (except at MOVTC_6)
                     ;       R2 - scratch
                     ;       R3 - Address of translation table (unchanged during execution)
                     ;       R4 - Signed difference between current lengths of source and destination
                     ;       R5 - Address of current byte in destination string
                     ;
                     ;       R10 - Access violation handler address (so can be used as scratch)
                     ;
                     ; Note that if R4 LSSU 0, then the value of R0 represents the number of bytes
                     ; in the source string remaining to be modified. There are also excess bytes
                     ; of the source string that will be untouched by the complete execution of
                     ; this instruction. (In fact, at completion, R0 will contain the number of
                     ; unmodified bytes.)
                     ;
                     ; Note further that entry at MOVTC_4 is impossible with R4 LSSU 0 because
                     ; MOVTC_4 indicates that an access violation occurred while storing the
                     ; fill character in the destination and that can only happen when the output
                     ; string is longer than the input string.
                     ;
                     ; The state that must be modified before being stored depends on the sign of
                     ; R4, which in turn depends on which of source and destination is longer.
                     ;
                     ;       R4 GEQU 0 => srclen LEQU dstlen
                     ;
                     ;               R0 - unchanged
                     ;               R1 - backed up by R0 (R1 <- R1 - R0)
                     ;               R4 - increased by R0 (R4 <- R4 + R0)
```

```
                     036F  2085 ;                  R5 - backed up by new value of R4 (R5 <- R5 - R4)
                     036F  2086 ;
                     036F  2087 ;          R4 LSSU 0 => srclen GTRU dstlen
                     036F  2088 ;
                     036F  2089 ;                  R0 - increased by negative of R4 (R0 <- R0 + ABS(R4))
                     036F  2090 ;                  R1 - backed up by input value of R0 (R1 <- R1 - R0)
                     036F  2091 ;                  R4 - replaced with input value of R0 (R4 <- R0)
                     036F  2092 ;                  R5 - backed up by new value of R4 (R5 <- R5 - R4)
                     036F  2093 ;
                     036F  2094 ;                  Note that R1 is modified before R0 is changed
                     036F  2095 ;-
                     036F  2096
                     036F  2097 MOVTC_6:
        04 AE    D6  036F  2098                INCL    PACK_L_SAVED_R1(SP)     ; Undo last fetch from source string
                     0372  2099
                     0372  2100 MOVTC_5:
04 AE    6E    C2  0372  2101                SUBL    PACK_L_SAVED_R0(SP),PACK_L_SAVED_R1(SP)
                     0376  2102                                                ; Point R1 to start of source string
           54    D5  0376  2103                TSTL    R4                      ; R4 LSSU 0 => srclen GTRU dstlen
           08    18  0378  2104                BGEQ    20$                     ; Branch if srclen LEQU dstlen
      5A   54    CE  037A  2105                MNEGL   R4,R10                  ; Save absloute value of difference
      54   6E    D0  037D  2106                MOVL    PACK_L_SAVED_R0(SP),R4  ; Get updated dstlen     (R4 <- R0)
      6E   5A    C0  0380  2107                ADDL    R10,PACK_L_SAVED_R0(SP) ; ... and updated srclen (R0 <- R0 - R4)
           03    11  0383  2108                BRB     30$
                     0385  2109
                     0385  2110 MOVTC_4:
      54   6E    C0  0385  2111 20$:          ADDL    PACK_L_SAVED_R0(SP),R4  ; Treat two strings as having same length
      55   54    C2  0388  2112 30$:          SUBL    R4,R5                   ; Point R5 to start of destination string
           C3    11  038B  2113                BRB     10$                     ; Join common code
```

```
                     038D  2115 ;+
                     038D  2116 ; MOVTUC Packing Routine
                     038D  2117 ;
                     038D  2118 ; Note that R7 is used to count the number of remaining characters in the
                     038D  2119 ; strings. The other two counts, R0 and R4, are set to contain their final
                     038D  2120 ; values.
                     038D  2121 ;
                     038D  2122 ; If R0 was initially smaller than R4,
                     038D  2123 ;
                     038D  2124 ;       R0 - 0
                     038D  2125 ;       R4 - Difference between R4 and R0 (R4-R0)
                     038D  2126 ;       R7 - Number of characters remaining in source (shorter) string
                     038D  2127 ;
                     038D  2128 ; If R0 was initially larger than R4,
                     038D  2129 ;
                     038D  2130 ;       R0 - Difference between R0 and R4 (R0-R4)
                     038D  2131 ;       R4 - 0
                     038D  2132 ;       R7 - Number of characters remaining in destination (shorter) string
                     038D  2133 ;
                     038D  2134 ; In either case, the stack when the exception occurred looks like this.
                     038D  2135 ;
                     038D  2136 ;       R6 - Scratch
                     038D  2137 ;       R7 - Number of characters remaining in two strings
                     038D  2138 ;
                     038D  2139 ;       00(R0) - Saved R6
                     038D  2140 ;       04(R0) - Saved R7
                     038D  2141 ;       08(R0) - Saved R10
                     038D  2142 ;       12(R0) - Saved R0
                     038D  2143 ;                <31:16> - Initial contents of R0
                     038D  2144 ;                <15:00> - Contents of R0 at time of latest entry to VAX$MOVTUC
                     038D  2145 ;       16(R0) - Saved R4
                     038D  2146 ;                <31:16> - Initial contents of R4
                     038D  2147 ;                <15:00> - Contents of R4 at time of latest entry to VAX$MOVTUC
                     038D  2148 ;       20(R0) - Return PC
                     038D  2149 ;
                     038D  2150 ; If the entry is at MOVTUC_2 or MOVTUC_3, then the source and
                     038D  2151 ; destination strings are out of synch and R1 must be adjusted
                     038D  2152 ; (decremented) to keep the two strings in step.
                     038D  2153 ;-
                     038D  2154
                     038D  2155 MOVTUC_2:
                     038D  2156 MOVTUC_3:
   04 AE    D7       038D  2157          DECL    PACK_L_SAVED_R1(SP)     ; Back up source string pointer
                     0390  2158
                     0390  2159 MOVTUC_1:
6E 57    C0          0390  2160          ADDL    R7,PACK_L_SAVED_R0(SP)  ; Readjust source string count
54 57    C0          0393  2161          ADDL    R7,R4                   ; ... and destination string count
56 80    7D          0396  2162          MOVQ    (R0)+,R6                ; Restore saved R6 and R7
   B5    11          0399  2163          BRB     10$                     ; Join exit path shared with MOVTC
                     039B  2164
                     039B  2165          .DISABLE        LOCAL_BLOCK
                     039B  2166
                     039B  2168          END_MARK_POINT
                     039B  2169
                     039B  2170          .END
```

```
...PC...                        = 000002C2
CMPC3_1                           00000329 R      02
CMPC3_B_DELTA_PC                = 00000003
CMPC5_1                           00000312 R      02
CMPC5_2                           00000312 R      02
CMPC5_3                           00000312 R      02
CMPC5_B_DELTA_PC                = 00000003
CMPC5_B_FILL                    = 00000002
CRC_1                             000002FB R      02
CRC_2                             000002F8 R      02
CRC_3                             000002F8 R      02
CRC_B_DELTA_PC                  = 0000000B
ESCAPE                            0000010A R      02
HANDLER_TABLE_BASE                00000000 R      04
IDENTICAL                         00000176 R      02
LOCC_1                            00000320 R      02
LOCC_B_CHAR                     = 00000002
LOCC_B_DELTA_PC                 = 00000003
MATCHC_1                          00000303 R      02
MATCHC_B_DELTA_PC               = 00000003
MODULE_BASE                     = 00000000 R      02
MODULE_END                      = 0000039B R      02
MOVE_BACKWARD                     00000063 R      02
MOVE_FORWARD                      00000027 R      02
MOVTC_1                           0000033A R      02
MOVTC_2                           00000337 R      02
MOVTC_3                           00000350 R      02
MOVTC_4                           00000385 R      02
MOVTC_5                           00000372 R      02
MOVTC_6                           0000036F R      02
MOVTC_B_DELTA_PC                = 0000000B
MOVTC_B_FLAGS                   = 00000009
MOVTC_M_FPD                     = 00000001
MOVTC_V_FPD                     = 00000000
MOVTC_W_INISRCLEN               = 00000002
MOVTUC_1                          00000390 R      02
MOVTUC_2                          0000038D R      02
MOVTUC_3                          0000038D R      02
MOVTUC_B_DELTA_PC               = 0000000B
MOVTUC_B_FLAGS                  = 00000009
MOVTUC_M_FPD                    = 00000001
MOVTUC_V_FPD                    = 00000000
MOVTUC_W_INISRCLEN              = 00000002
NO_MATCH                          000001A4 R      02
PACK_L_SAVED_R0                 = 00000000
PACK_L_SAVED_R1                 = 00000004
PACK_L_SAVED_R2                 = 00000008
PACK_L_SAVED_R3                 = 0000000C
PACK_M_ACCVIO                   = 00000200
PACK_M_FPD                      = 00000100
PACK_V_FPD                      = 00000008
PC_TABLE_BASE                     00000000 R      03
PSL$M_V                         = 00000002
RESET_STRINGS                     00000264 R      02
SCANC_1                           0000031B R      02
SCANC_2                           00000318 R      02
SCANC_B_DELTA_PC                = 00000003
SKPC_1                            00000320 R      02
SKPC_B_CHAR                     = 00000002
SKPC_B_DELTA_PC                 = 00000003
SPANC_1                           0000031B R      02
SPANC_2                           00000318 R      02
SPANC_B_DELTA_PC                = 00000003
STRING_ACCVIO                     000002D5 R      02
TABLE_SIZE                      = 00000017
TOP_OF_LOOP                       0000026E R      02
VAX$CMPC3                         0000012C RG     02
VAX$CMPC5                         00000152 RG     02
VAX$CRC                           00000292 RG     02
VAX$LOCC                          000001F7 RG     02
VAX$MATCHC                        00000243 RG     02
VAX$MOVTC                         00000000 RG     02
VAX$MOVTUC                        000000A0 RG     02
VAX$REFLECT_FAULT                 ******** **   X  00
VAX$SCANC                         000001A9 RG     02
VAX$SKPC                          0000021D RG     02
VAX$SPANC                         000001D0 RG     02
```

Psect synopsis

PSECT name	Allocation	PSECT No.	Attributes
. ABS .	00000000 (0.)	00 (0.)	NOPIC USR CON ABS LCL NOSHR NOEXE NORD NOWRT NOVEC BYTE
ABS	00000000 (0.)	01 (1.)	NOPIC USR CON ABS LCL NOSHR EXE RD WRT NOVEC BYTE
VAX$CODE	0000039B (923.)	02 (2.)	PIC USR CON REL LCL SHR EXE RD NOWRT NOVEC LONG
PC_TABLE	0000002E (46.)	03 (3.)	PIC USR CON REL LCL SHR NOEXE RD NOWRT NOVEC BYTE
HANDLER_TABLE	0000002E (46.)	04 (4.)	PIC USR CON REL LCL SHR NOEXE RD NOWRT NOVEC BYTE

Performance indicators

Phase	Page faults	CPU Time	Elapsed Time
Initialization	16	00:00:00.05	00:00:01.23
Command processing	76	00:00:00.46	00:00:04.46
Pass 1	189	00:00:05.84	00:00:21.67
Symbol table sort	0	00:00:00.25	00:00:00.77
Pass 2	370	00:00:04.05	00:00:15.02
Symbol table output	9	00:00:00.07	00:00:00.07
Psect synopsis output	2	00:00:00.03	00:00:00.03
Cross-reference output	0	00:00:00.00	00:00:00.00
Assembler run totals	662	00:00:10.75	00:00:43.25

The working set limit was 1500 pages.
41149 bytes (81 pages) of virtual memory were used to buffer the intermediate code.
There were 20 pages of symbol table space allocated to hold 197 non-local and 56 local symbols.
2170 source lines were read in Pass 1, producing 20 object records in Pass 2.
26 pages of virtual memory were used to define 24 macros.

Macro library statistics

Macro library name	Macros defined
_255DUA28:[EMULAT.OBJ]VAXMACROS.MLB;1	15
_255DUA28:[SYSLIB]STARLET.MLB;2	5
TOTALS (all libraries)	20

301 GETS were required to define 20 macros.

There were no errors, warnings or information messages.

```
MACRO/LIS=LIS$:VAXSTRING/OBJ=OBJ$:VAXSTRING MSRC$:VAXSTRING/UPDATE=(ENH$:VAXSTRING)+LIB$:VAXMACROS/LIB
```

VAXLOAD
LIS

ERFBRIEF
MAP

ERFPROC1
MAP

ERFDISK
MAP

ERFBUS
MAP

ERFINICOM
MAP

ERFCOMMON
MAP

VAXSTATUS
LIS

ENCRYP ERF

ENCSTUBS
LIS

ERF
MAP

ERFPROC2
MAP

VAXSTRING
LIS